In This Issue *Economy of Steam-Electric Generation at the Inspiration Copper Company's Plant in Arizona*

JOURNAL OF ELECTRICITY

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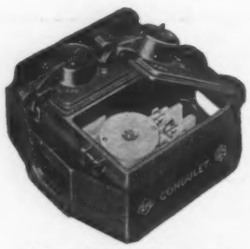

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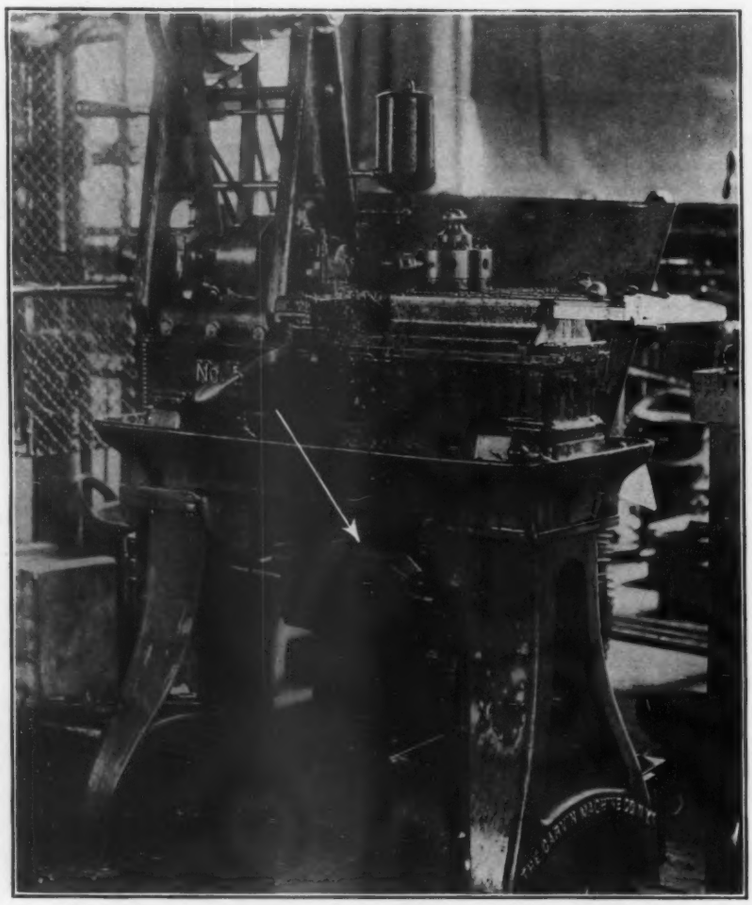

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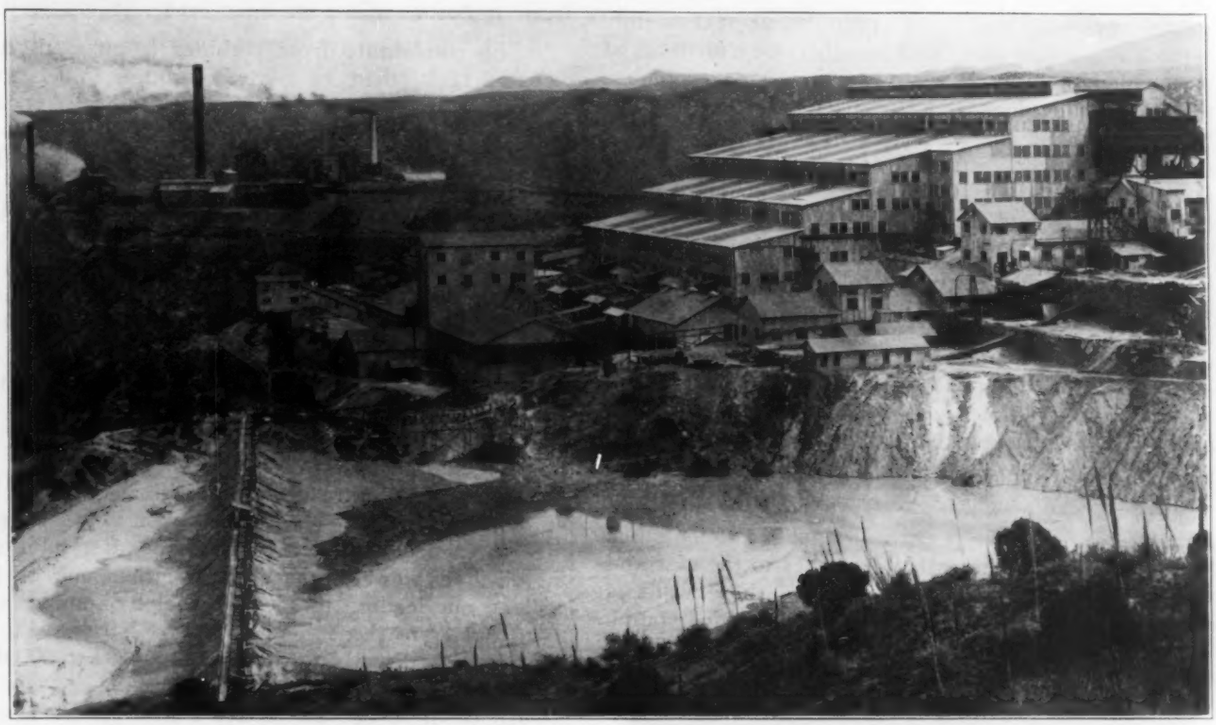


Inspiration Mill, with Tailings Dam in Foreground and International Smelter and Power Plant in Background

THE ELECTRICAL WINNING OF INSPIRATION COPPER

BY A. H. HALLORAN

(Electricity in the great mining districts of the West is producing economic results hitherto unexperienced in the history of mining. Here is an article that tells how and why the great Inspiration Copper Company of Arizona is today on the lips of all who desire to point to present day efficient progress in electrical applications in mining. New economic ideas have been here worked out in fuel oil control that are exceptionally interesting as shown from detailed operating figures that are given. Interesting uses of electricity in mining, concentration and smelting are also set forth. —The Editor.)

Power Plant

ELECTRICITY is as essential to the mining, milling, smelting and refining of copper as is copper to the generation, transmission, distribution and utilization of electricity. Hence, Western copper producers are foremost among the industrial users of electric power to improve the economy and efficiency of their plants. Especially is this true in Arizona, where hydroelectric power is limited in amount and the chief reliance is placed upon prime movers driven by steam supplied from oil-fired boilers. Whatever lessens the oil consumption reduces the cost of copper.

Consequently the record of nearly 286 mean kw.-hrs. per barrel of oil which was developed during the twelve months' period from July 1916 to June 1917, by the Inspiration Consolidated Copper Company at Miami, Arizona, arouses interest as to the methods and equipment employed to attain this remarkable result.

Power for the operation of the Inspiration mine and mill and the International smelter is supplied by

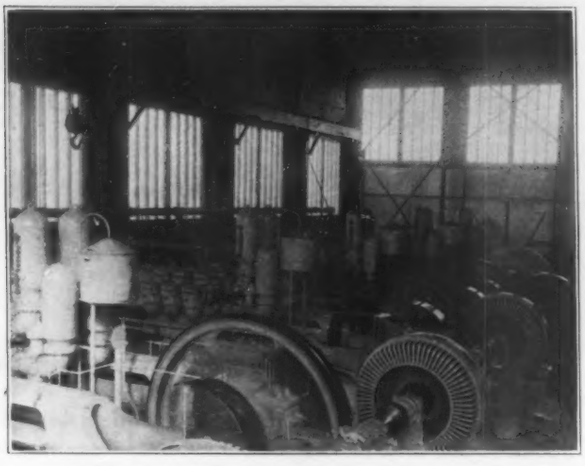
the U. S. Reclamation Service from the hydroelectric plant at Roosevelt Dam and from the Inspiration steam plant near the smelter. As the available hydroelectric power, transmitted 40 miles at 40,000 volts, is not sufficient to meet the requirements of the mine, mill and smelter, dependence must be placed on the steam station. Both sources supply 25 cycle current distributed at 2200 volts.

The power station, a substantial structure of concrete steel, houses three 6000 kw. turbo-generator sets with auxiliaries and three reciprocating blowing engines, each having a capacity of 15,000 cu. ft. of free air per minute and compressing to 15 lb. per square in. Steam is supplied from eight 713 h.p. boilers in an adjoining building and from seven waste-heat boilers served by waste gases from reverberatory furnaces at the smelter. Normally, the waste-heat steam supplies the blowing engines, the surplus passing to the turbine header; the oil-fired steam passes directly to the turbo-generators. Accurate measurement and records are kept as to relative amounts from each source. The smelter is credited with the steam generated and debited with power received. The waste-heat boilers recover approximately half the total heat in the oil burned in the reverberatory furnaces.

This article will be confined to the oil-fired plant, together with brief reference to the various uses of the electric current about the mine and mill. The remarkable operating efficiency obtained is entirely independent of the waste-heat plant.

Water Cycle

All of the new water used at the power house, concentrator and smelter is derived from six wells which have been sunk in the valley 2½ miles to the east and 430 ft. lower than the mill. Each of these wells is equipped with a 24-in. multi-stage turbine pump driven by a 150 h.p. motor. All pumps discharge through wood-stave pipe-lines to a common sump-



Pumping Station Interior

tank having a capacity of 235,000 gal. A battery of six 1200 gal. per min. horizontal duplex, double acting pumps, direct driven through herring-bone gears by 300 h.p. 6600 volt Westinghouse synchronous motors raise the water to a 3,000,000 gal. concrete reservoir above the concentrator. The delivery main is a 20 in. steel pipe, 14,600 ft. long with a total rise of 520 ft. Also by means of an elaborate system of tailings storage and settling ponds and pumps, water used in the milling process is recovered and returned to a mill head tank for re-use in the concentrator.

Raw water for the power plant is obtained through a 10 in. service from the reservoir with an emergency 10 in. tap from the 20 in. main.

The raw water consumption during November, 1916, which represents average conditions, was as follows:

House Service—Turbine room	277,200	gallons
House Service—Oil fired plant	107,100	"
House Service—Waste heat plant.....	88,400	"
Water to hot process purifier for boiler feed	3,122,800	"
Water to Booth softener for spray pond....	15,378,200	"

The condensate from turbines is pumped to an elevated tank, then circulated through Volz heaters in the condensers serving the blowing engines where the temperature is raised about 30 degrees F., then a Platt heater increases temperature to 180 to 190 deg. F.

Condensate only is supplied to the oil fired boilers, the surplus being mixed with sufficient treated water to meet requirements of the waste heat boilers.

The water to be treated for boiler feed make-up passes over a tipping weigher, through Volz heaters, where its temperature is increased from 60 deg. to around 130 deg. F., then to a Sorge-Cochrane hot process purifier, where it is further heated to about 205 deg. F., then mixed with proper proportion of lime and soda ash, settled and filtered.

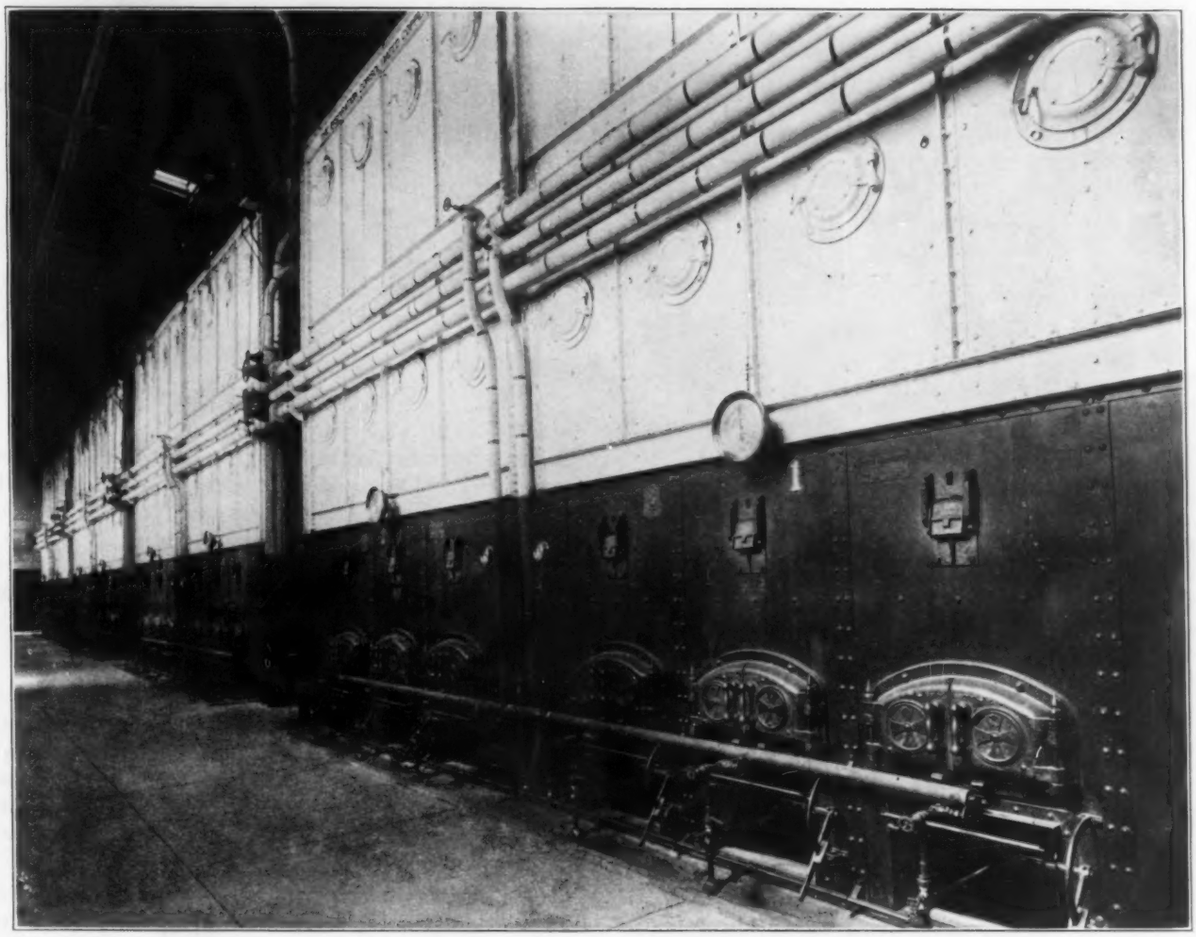
A Lea V-notch recorder and a Cole-Bergman tipping weigher in series check the quantity of water supplied to each boiler plant. The feed-water pumps at the oil-fired plant discharge into either one of two headers, one leading to a Green fuel economizer supplying water to the boilers at 230 to 240 deg. F., the other feeding directly to the boilers at 180 to 200 deg. F. in case the economizers are cut out.

All of these operations are controlled by a very complete system of piping and valves so arranged that in emergency there need be no interruption in the supply to the pumps. If the main pressure supply should fail, water may be drawn from the spray pond for feed pumps and turbine bearings. There is sufficient capacity in tanks on the roof to supply the cooling header for 30 minutes while the valves are being opened from the 20 in. main or the spray pond. A system of float alarms in tanks gives ample warning of any failure of normal supply.

All make-up to the spray pond is treated with hydrated lime in a Booth softener which reduces the carbonates to less than 2 grains to the gallon. In order to prevent excessive scaling of condensers the concentration of carbonates, the only salts in the circulating water which would be precipitated at the temperatures prevailing in the condensers, is not permitted to exceed 6-7 grain per gallon. During the period aforementioned 5,543,000 gallons of water was discharged from the spray pond to this end.

Oil Cycle

Fuel oil is delivered directly to the plant by rail. The oil is discharged from tank cars into a carefully calibrated receiving tank where the volume is meas-



BOILERS EQUIPPED WITH AUTOMATIC OIL FIRING SYSTEM

Here may be seen an improved system for regulating the fuel that is fed to the boiler furnaces. The oil supply is controlled from one central point, and with it, the steam used in atomizing the oil and the quantity of air admitted to the furnace are also under delicate control. Any fluctuation in steam pressure operates a governor whose power arm controls a bleeder valve on the oil pump discharge line, thus cutting off the oil supply, if the steam pressure is too high and reducing it if too low. Any change in pressure in the oil main, in turn, controls the amount of steam for atomizing and of air for burning the oil.

ured with a rod, corrected for temperature and checked against the invoice. A sample from each car is tested for gravity and moisture. Twenty single car samples are then intimately mixed and a composite sample tested in a bomb calorimeter for heating value and sulphur content. During the 12 months ending June 30, 1917, when 2065 cars of fuel oil were handled, the total shortage by volume and scale weight was 627 bbl., equivalent to about 0.1 per cent of the total quantity billed.

From the receiving tank the oil is pumped either to one of two 30,000 bbl. main storage tanks, supplying the power house and the smelter respectively, or to one of the 800 bbl. feed tanks.

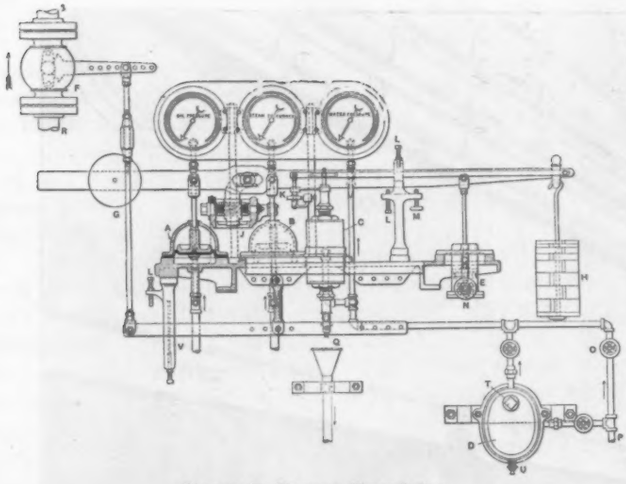
The oil-fired plant now contains eight 713 h.p. Stirling boilers, fitted with asbestos steel casings lined and set in four batteries of two each. These units were designed for 210 lb. operating pressure, and are equipped with Foster superheaters which add slightly more than 100 degrees F. to the steam at rating.

Four new boilers are under construction for the oil fired plant, and three additional units for the waste heat plant—all for 250 lb. working pressure. The new superheatrs in the oil fired boilers will superheat the steam 140 degrees, and the present superheaters are to be altered so that higher temperature steam will be obtained therefrom.

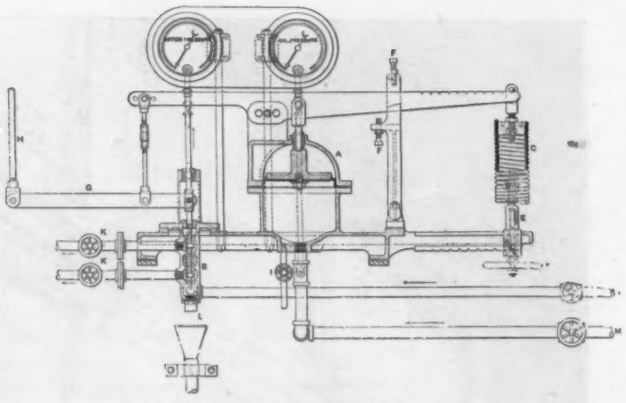
Perhaps the most interesting detail in the boiler plant is the automatic system of firing employed to minimize labor and improve efficiency in burning the oil. This is the Moore patent fuel oil regulating system which, from one central point, controls the oil supply, the atomizing steam and the amount of air to each furnace.

This regulator is actuated by the pressure from the main steam header so that any variation in steam requirements will cause a corresponding change in the amount of oil fired, due to an increase or decrease in the steam supply to the oil pumps and atomizers. Any fluctuation in steam pressure operates a governor whose power arm controls a bleeder valve on the oil pump discharge line, thus cutting off the oil supply if the steam pressure is too high and reducing it if too low. Any change in pressure in the oil main, in turn, controls the amount of steam for atomizing and of air for burning the oil.

It is found that a simple straight line relationship exists between the amount of steam required for atomizing the oil and the amount of oil burned. Two diaphragms are employed to balance the pressures in



Steam-to-Burner Regulator



Damper Controller

the oil main and in the steam main connected to the burners, these pressures in this instance being 200 lb. and 80 lb. respectively. Any difference in oil pressure operates a rotary chronometer valve in the steam main through the medium of a fulcrum, water motor and lever connecting rod. Likewise the variance in oil pressure actuates a counterweighted rock shaft which moves the dampers so as to vary the amount of air admitted for combustion.

In operation, after the boilers are well loaded, the steam-to-burner regulator and the damper controller are carefully set and adjusted from a determination of the amount of CO_2 in the chimney gases. An occasional re-adjustment is required after a peak load is passed, the firing otherwise being entirely automatic.

The main generating units are three in number, being 6000 kw., 6600 volt, 25 cycles General Electric alternators driven at 1500 r.p.m. by Curtis turbines. Steam is condensed in Wheeler admiralty surface condensers operated in connection with a spray pond for cooling the water and rotative dry vacuum pumps remove the non-condensable vapors from the condensers.

The spray pond is perhaps the one feature of this installation which is not giving entire satisfaction.

Little is known of the laws of cooling as applied to the reduction of the temperature of water mixed with air currents, and the manufacturers of spray apparatus have had small experience in the design of cooling systems of heavy capacity, such as would be required by a large power plant located in a warm climate, and remote from any considerable body of water.

The agreement is now quite general that the Inspiration spray pond should have been spread over at least twice its present area. Owing to limited ground space the pond cannot be extended the desired amount and additional cooling capacity is to be obtained by the installation of towers.

Considerable trouble has also been experienced from algae in the pond which flake off in large pieces and cause almost as much trouble as sea-weed on the coast. They seem to flourish with increase in the amount of carbonates and in warm weather especially. Of the numerous treatments that have been tried out, formaldehyde has given the most satisfactory results. Whiile the growth can be prevented only by the use of such large quantity of the chemicial as would be prohibitive in cost, a comparatively small amount administered at regular intervals will hold the growth in check sufficiently to prevent serious trouble.

Operating Results

An exhaustive set of operating reports are kept for each month, particular attention being paid to the pro-rating of water, fuel oil, auxiliary electric power, repairs, lubricants and labor to the International Smelting Company and the Inspiration Consolidated Copper Company, the joint owners of the power plant.

As the waste-heat steam is delivered to the turbine header at a lower temperature than the oil-fired steam, a deduction of 1 per cent is made for each 10.15 degrees that the waste-heat steam falls below the oil-fired steam to determine the equivalent value as delivered to the turbine feed. This factor of 10.15 was experimentally developed during factory tests. An example is afforded by the typical month of December 1916, when the waste-head plant delivered 38,278,600 lb. of steam at 431.2 degrees F. absolute, whereas 469.9 degrees was the temperature of the oil-fired steam at the turbine throttle. The equivalent quantity of waste heat steam, referred to oil-fired steam as standard would be

$$1.00 - \frac{(476.9 - 431.2)}{(10.15 \times 100)} Q = (1.00 - 0.045 +) Q$$

$$= 0.955 \times 38{,}278{,}600 = 36{,}553{,}400 \text{ lb.}$$

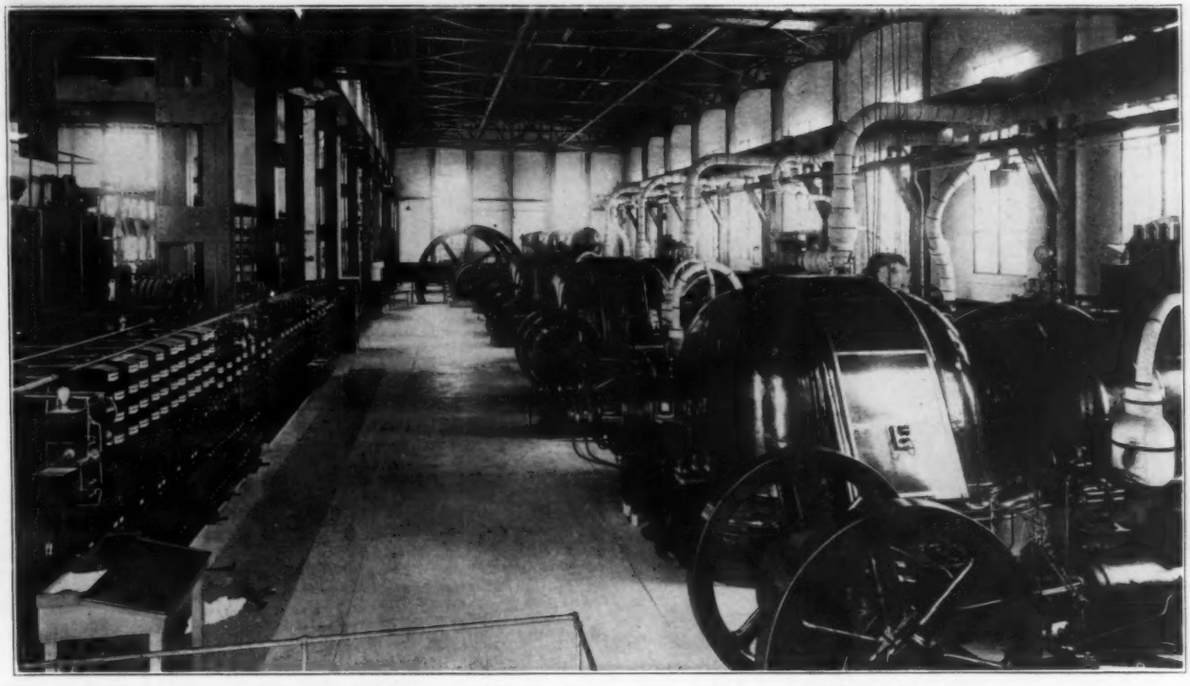
During the same period 16,512.8 bbl. of oil (including shortage) was billed against the oil fired plant; 77,278,300 lb. of steam was generated and 74,785,000 lb. was delivered to the turbines.

The total generation was 7,247,500 kw.-hrs., of which 23,751 kw.-hrs. was consumed in the process.

Allowing the waste heat plant a proportionate quantity of steam for boiler room auxiliaries as was consumed in the oil fired plant, the equivalent gross steam for electrical generation was

$7759/7479 \times (74{,}785{,}000 + 38{,}278{,}600)$ lb.

and the apparent economy of the electrical plant was



Power Plant Interior. Turbines in Foreground. Blowing Engines in Rear

$$\frac{77{,}278{,}300}{7729} \times \text{Net elec. production} \times (74{,}785{,}000 + 38{,}278{,}600) \text{ bbl. oil billed.}$$

$$= \frac{74{,}785{,}000}{74{,}785{,}000 + 38{,}278{,}600} \times \frac{7{,}223{,}749}{16{,}512.8} = 289.3 \text{ net}$$

kw.-hr. per bbl. of oil billed.

Had all of the steam used for electrical generation been generated by the oil fired boilers, the gross weight of steam would have been

$77{,}278{,}300 + 7729/7479 \times 36{,}553{,}400$ lb., therefore the plant economy, compensated for the lower temperature steam from the waste heat boilers which was used in turbines, was

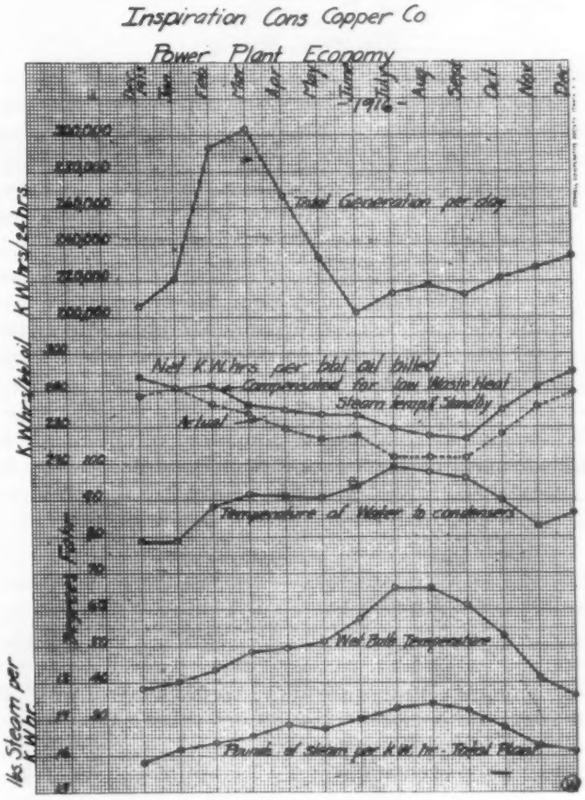
$$\frac{74{,}785{,}000}{74{,}785{,}000 + 36{,}553{,}400} \times \frac{7{,}223{,}749}{16{,}512.8} = 293.8 \text{ net}$$

kw.-hr. per bbl. of oil billed, compensated for lower heat content of the waste heat steam used.

Under favorable load conditions in the winter, when the circulating water is cold compared to summer temperatures, slightly over 300 kw.-hr. per bbl. of oil has been developed. In the hot season, with injection water 100 degrees and higher, plant economy will fall below 280 kw.-hr. per bbl.

The distribution of electric power was as follows: 4,646,600 kw.-hrs. was delivered to the mill, 1,151,300 kw.-hrs. to the mine, 959,900 to the pumping plants, 231,844 to the smelter and 205,900 to the Miami Copper Company. The various power plant auxiliaries took 51,956 kw.-hrs. as follows:

	kw.-hrs.		kw.-hrs.
Hot process water treatment	150	Waste-heat boiler dept.	5,593
Cold process water treatment	490	Converter air compression—Direct	26,398
Oil-fired boiler dept.	9,153	Electrical generation	10,170



Graph of Power Plant Economy

Re-distribution of first four items, gives convertor air compression 27,906 and electrical generation 23,751. On the basis of the first 14 months' operation the average net efficiency of the boiler and economizer, after deducting the steam used for atomizing, was 82.9 per cent. The over-all thermal efficiency of the plant during December, 1916, with a machine

Inspiration Rock House. Shaft, Hoist House and Outdoor Substations

load factor of 82.5 per cent was 16.32 per cent using oil-fired steam as the standard, the average pressure on the turbine being 1.9316 in. mercury and the average temperature of the circulating water inlet to the condenser 76.81 deg. F.

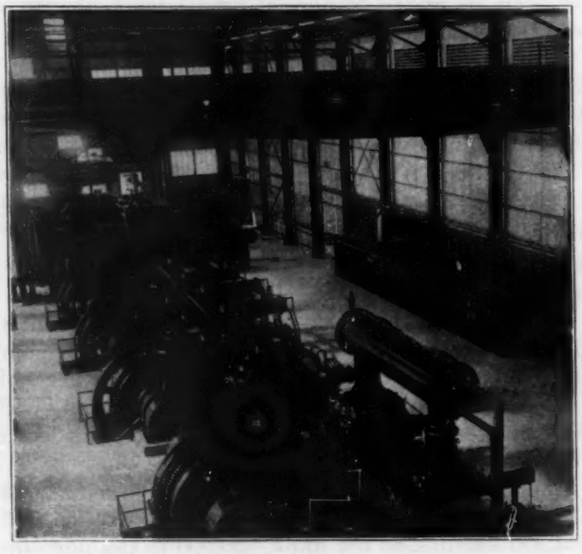
Electrical Mining

Of even greater interest than these remarkable operating results is the application of this electric power to the winning of the pure metallic copper from its ores. There is hardly a step in the long and intricate processes of mining, milling, smelting and refining which is not directly or indirectly dependent upon electricity.

In the mine, electric motors drive the compressors which supply the air for drilling the holes which receive the dynamite which shatters the rock. Likewise wise, with the compressed air locomotives, which haul the ore from the stope to the shaft. Electricity enters into the handling and crushing of the ore. The electric telephone establishes constant communication with all parts of the mine. Electric pumps carry off the water, electric lamps light the shaft, and an electric hoist handles the men.

Current is received at the mine substation from the Roosevelt Dam at 40,000 volts and from the stream plant at 6600 volts, being stepped down to 2200 volts by means of four three-phase transformers. In the power house is a 22 panel switchboard with remote control of incoming and outgoing circuits. Two 430 h.p. 2200 volt synchronous motors drive the two Ingersoll four-stage compressors which supply air at 1000 lb. pressure to the mine locomotives. There is also a 2-stage Nordberg driven by a 1150 h.p. synchronous motor and a 2-stage Ingersoll Rand compressor driven by a 500 h.p. motor which supply air at 100 lb. pressure to the rock drills. Two 100 kw. motor generator sets furnish exciting current for the four synchronous motors. A motor generator set gives direct current for the operation of the two 585 h.p. motors operating the two ore hoists and the 190 h.p. elevator motor running the man-hoist. All the eletcrical equipment in the power house is of General Electric manufacture. Motors of 50 h.p. and over are operated at 2200 volts, while smaller motors operare at 440 volts. The entire equipment was designed to handle 7500 tons daily, but is giving an output of 22,000 tons.

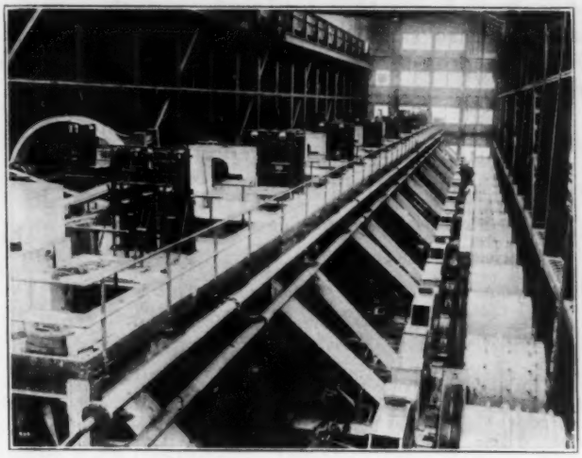
Crude ore from the stope chutes is hauled in 25-car trains by compressed air locomotives to the loading station at the shaft where the cars are dumped, five at a time, into 1600-ton ore pockets by motor-operated tipples. There are two of these at the 600-ft. level, one for each of the two ore tables, and one at the 400 ft. level. These tipplers are driven by 35 h.p. Westinghouse motors running continuously in one direction



Interior of Hoist House, Showing Compressors and Hoists

and geared to a driving shaft which is engaged by a friction clutch on intermediate shafting for starting and stopping the tipplers. Each tippler is 56 ft. long and dumps the cars by making a complete revolution in 15 seconds.

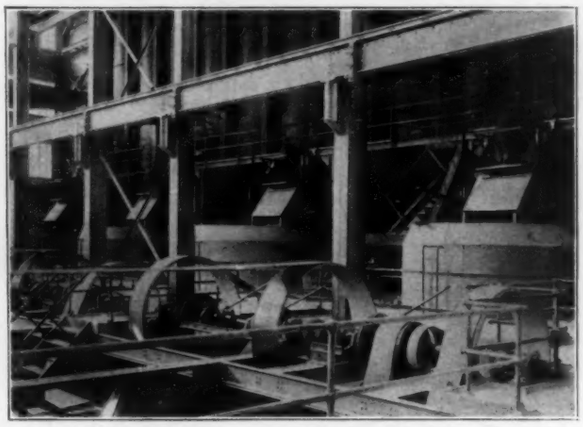
The ore skips are hoisted in balance, the hoists having cylindrical drums 10 ft. in diameter with 65 in. face. Each carries 1000 ft. of 1¾ in. steel cable. The skip, in descending, is automatically filled from a weighing machine at the ore-pocket chute. The skips automatically dump into bins supplying the crushers.



Ball Mill Starting Panels and Motor Platform

The main crushing plant is operated in four units, each consisting of a No. 8 gyratory crusher, crushing to a maximum of 3¼ in., a 30 in. belt conveyor and two 48 in. Symons disc grinders crushing to 1½ in., the unit being belt driven by a 200 h.p. motor. Two 150 h.p. motors drive a belt conveyor lifting the crushed ore to a sampler and distributor, which by means of four 50 h.p. motors on moving carriages deliver the ore into 25,000 ton storage bins. The crushed ore is then hauled in cars to the concentrating mill in 14-car trains by steam locomotives. The plant is also equipped with two 20-ton electric cranes.

The man-hoist is in a separate shaft-compartment and is operated from the cage, the hoist, motor gen-



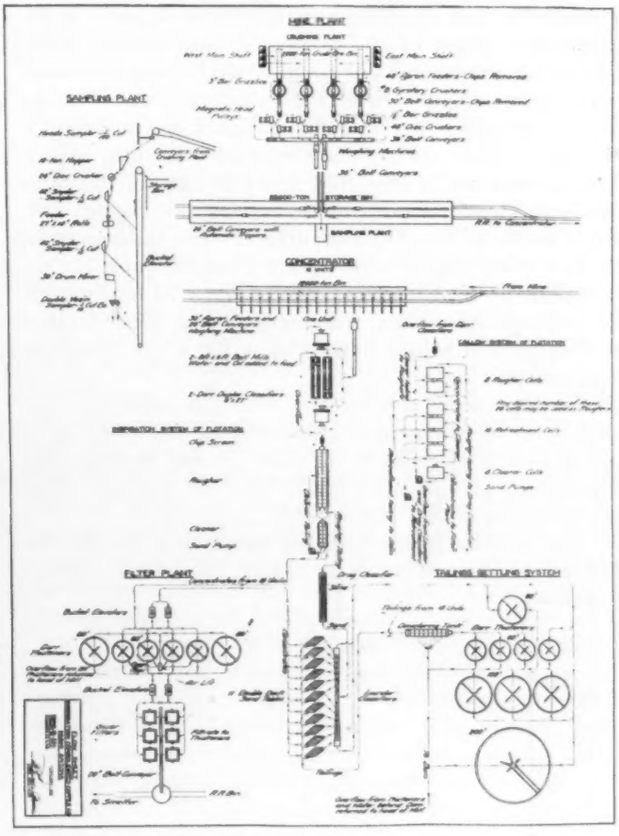
Gyratory Crushers and Drive

erator set and control apparatus being in the hoist house 220 ft. distant. The cage is also equipped with a telephone and annunciator system. The hoist is driven by a 158 h.p. d.c. motor, getting its current from a 130 kw. motor-generator set.

Electrical Concentration

At the concentrator, 1¾ miles from the mine, is another outdoor substation having eight 2000 k.v.a. oil-insulated, water-cooled, three-phase transformers, four on the 40,000 volt line and four on the 6600 volt line. These step down to 2200 volts, the circuits being led to a separate building housing a 13-panel switchboard, each panel being provided with double throw switch for connection to either the hydro or the steam

Many Ball Mills and Flotation Machines



Flow Sheet

supply. Six panels care for the six concentrator units, three for the centrifugal blowers, and one each for lighting the filter plant, shop room and Root blower. There is also an 11 kw. motor generator set for electrolytic work in the assay office.

The function of the concentrating mill is to separate the copper sulphide (chalcocite) from the rock in

which it is finely dissimulated. This is accomplished by a series of crushing and flotation operations which will be briefly described.

From the 12,000 ton receiving bins eighteen 30 in. apron feeders deliver the ore to a 20 in. inclined conveyor belt driven by a 50 h.p. motor, the belt discharging into two hoppers which supply the six concentrating units.

Each of the concentrating units consists of a Marcy ball mill and a Dorr classifier, together with flotation cells which treat the overflow from the classifier. The ball mills crush the ore so that 60 per cent will pass a 200 mesh screen and 38½ per cent more a 48 in. screen. This slime forms the overflow from the classifier which is treated in the flotation cells, the oversize being returned to the mills for regrinding. Each ball mill is driven through herring bone gears and a Franckel flexible coupling by a 225 h.p. three-phase induction motor. A 50 h.p. motor drives each of the six classifiiers and conveyors.

Three types of flotation machines are in operation, four sections being equipped with Callow machines, thirteen with Inspiration machines and one with a Mineral Separator machinie. These give three products, a clean concentrate which goes to the filter plant, a middling which goes to a drag classifier for retreatment and a tailing which goes to waste. A detailed description of the process is unnecessary here, it being deemed sufficient to state that a small amount of oil added to the ore in the grinding mill coats the sulphide particles but not the gangue; the mixture is allowed to flow through a series of cells into which low pressure air is admitted so as to agitate the mixture and form a froth which carries the copper sulphiide and is floated off the surface. The tailings from the first roughing treatment are pumped back for retreatment by a sand pump driven by a 50 h.p. motor, the tailings from this treatment being concentrated on Diester belt tables driven by a 105 k.v.a. synchronous motor.

Low pressure air for the flotation cells is supplied by four centrifugal compressors, each having a capacity of 23,000 cu. ft. of inlet air per minute and discharging at a pressure of 5.75 lb. per sq. in. They are driven by a 720 h.p. motor.

The concentrates from the flotation cells and tables, containing 90 per cent water, pass to five Dorr tanks where they settle to the bottom and are drained off as a thick pulp containing 42 per cent moisture, while the overflowing clean water goes to the return water sump. The thickened pulp is elevated to Oliver filters which reduce the moisture content to 17 per cent. The concentrates are then carried in hopper-bottomed steel cars to unloading bins at the smelter where they are sampled and delivered by belt conveyor to bedding bins for mixture with limestone and pyrite.

Mine and Mill Power Consumption

The following table shows the power consumption at the mine and mill for August, 1916:

Power Consumption at Mill and Mine

						kw.-hrs. per ton
Mining—Tons mined, 493,900—				kw.-hrs.		
Power for machine drills and vent, 100 lb. air.				651,300		1.319
Power for air hauling, 1000 lb. air				185,790*		.376
Power for ore hoisting				358,320		.725
Power for lights				9,300		.019
Power for miscellaneous mine dept. uses				59,760		.121
					1,264,470	2.56
Coarse Crushing, Conveying and Sampling:						
Tons treated, 493,900				201,000		.409
Concentrator—Fine Crushing—						
Tons treated, 498,270				4,914,980		9.86
Flotation				1,576,670		3.16
		Tons	kw.-hrs.			
Tables—	kw.-hrs.	treated	per ton			
Power for tables	182,760	245,790	.74			
Power for drag belt classifiers, separating sands for concentration	20,430	469,274	.04	203,190		.41
Filters— Concentrates Kilowatt hours per ton 5.71				109,110		.22
Tailings Disposal—						
Motors for Dorr dewatering tanks				4,980		.01
Water Reclamation—						
Repumping water from settling ponds				941,365		1.89
Sundry Power—						
Machine and carpenter shops, incline hoists, etc.				30,950		.06
Lights				25,170		.05
Pumping New Water				655,485		
Lights				1,320	656,805	1.32
Crushing Rock for Concrete				1,000		
Lights for Offices, Dormitory, Dwellings, etc.				1,410	8,666,630	
Total kilowatt hours					9,931,100	19.95

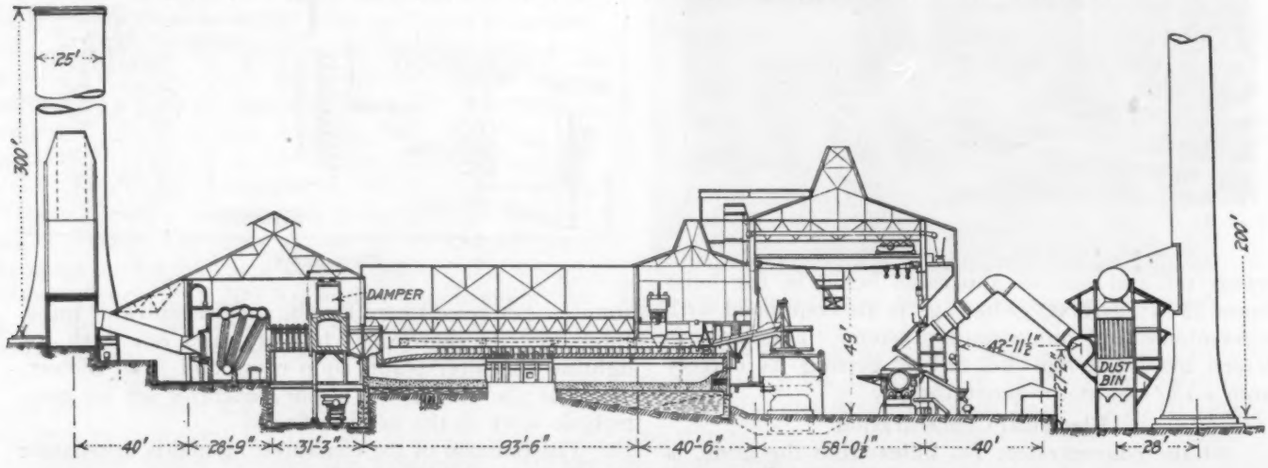
	kw.-hrs per ton
Power for mining	2.56
Power for milling	16.07
Power for pumping new water	1.32
	19.95

ton of daily capacity.

*Average mine haul, .475 miles. Kilowatt hours per ton mile, .796. The average power requirement in August was .83 of a kilowatt per

Electricity in Smelting

The smelting of sulphide copper concentrates consists primarily in the elimination of sulphur by heat



Typical Cross Section of International Smelting Company's Plant.

just as mill concentration is essentially the elimination of silica by water. The heat is primarily produced from fuel oil and secondarily from burning sulphur. Consequently every effort is made to minimize the oil consumption, just as the millman tries to conserve his water supply. Thus the smelterman and millman are as much interested in saving oil and water as is the power plant engineer.

At the smelter the concentrates are first dried in five Wedge mechanical roasting furnaces which employ fuel oil to remove the last trace of moisture, 5.51 gal. of oil being required per ton of concentrate treated. The temperature is kept low enough to prevent roasting of the ore as the concentrates do not contain enough sulphur to avoid making a copper matte so high in sulphur that the slag is not clean. This is why pyrite is added to the charge.

As the gases from these calcines carry much flue dust a Cottrell electrical precipitation equipment has been installed to recover the dust. In this process a high voltage electric discharge cleans the gases of all dust. This installation consists of 12 rectifying units which supply uni-directional current at from 50,000 to 100,000 volts. For each of the 12 units the dust collects in 20 tubes, 13 in. outside diameter and 15 ft. long, the dust being shaken off by striking the tubes with hammers.

The calcines from the Wedge furnaces are mixed with siliceious ore and limestone and then charged into three 21 x 100 ft. reverberatory furnaces, the charging being accomplished by motor-driven drag-chain conveyors. By the aid of .79 bbl. of oil per ton of charge the copper matte is produced from the calcinied concentrates. Through the agency of Stirling boilers, installed between the furnaces and chimney, about half the heat value of this oil is recovered as steam as has heretofore been explained.

A graphic log is kept each month to check the results from the waste heat boilers. This shows the market value in dollars of the steam delivered, the amount of oil burned in the reverberatories, the total equivalent evaporation, the equivalent unit evaporation, (lb. H_2O/lb. oil) the temperature of the exit gases and the degrees of superheat.

Electric cranes of 40 ton capacity carry the copper matte from the reverberatory furnaces to the five converters when the last trace of sulphur is burned out by blowing in 12 lb. air from the Nordberg engines in the main power plant. Each converter produces 95 tons of copper daily which is cast into 247 lb. bars for shipment to the refineries. An electric railway system handles the slag cars.

Thus has been briefly sketched the electrical winning of metallic copper from its ores and sulphides. In conclusion the writer wishes to express his indebtedness for information obtained and courtesies granted from W. W. Jourdin, chief engineer of the Inspiration power plant. The general layout for the power plant was made jointly by Mr. John Langton, consulting engineer for the Inspiration Copper Company, and by Chas. C. Moore & Company, engineers. Final details of the installation and development of economy were left to Chas. C. Moore & Company, to whom their chief engineer, C. R. Weymouth, furnished information regarding sizes of apparatus. Seldom are such economies practiced and such high efficiencies obtained in industrial power installations. Great credit is due for the wonderful showing made.

METAL FLUME AND ITS VALUE FROM AN ECONOMICAL STANDPOINT

In making plans for new irrigation projects, or the betterment of the existing one, it should be the object of the engineers or the people interested to get out of every dollar invested the greatest possible return, in service. Experience has fully demonstrated that the wooden flume for conveying water to an irrigated district is a thing of the past. The very best life that can be allowed for a wooden flume is from eight to twelve years, and after the sixth year, the maintenance charge becomes almost prohibitive. These are facts from experience.

The usual bonds sold for irrigation purposes run twenty years and it would be very hard at the present time to get a financial institution to consider buying the bonds of a district which contemplated building their flumes of such a material that at the end of a period of twelve years they would be called upon to refinance for rebuilding the flume. In making this investment in wooden flumes you are really furnishing a security that has a life of a little over one-half of your financial obligation. Then you are confronted with raising more money to replace the original wooden flumes, which money immediately begins to bear interest besides having to pay for eight years interest charges on your original investment. In buying a metal flume of the proper type, made of the right metals, you will probably expend slightly more in your first investment, but there will be no period during the life of your bond issue, or for years after, when you will have to come before the people and ask a new issue of securities on which to obtain money to replace your flume. The question often arises, if the district expends money for a metal flume, how about the wood substructure? Experience gathered from nearly all the irrigated districts conclusively shows that with a metal flume you eliminate leakage, and it is the leakage from a wooden flume that causes the substructure to deteriorate and washout the foundations. The value and equal distribution of water on all the projects is becoming of vital importance.

In building the wooden flume you not only have to consider the weight of the water which is transported, but the weight of the flume box in itself is quite an item. Compare these weights with the weight of a metal flume, and you can readily see why the cost of light substructure used with the metal is so much less. The erection cost of the substructure used with the metal is also lower and the maintenance charge is a very small fraction of that of any other type. In the Yakima country there is a case of a ditch rider who looks after twelve miles of ditch. On the twelve miles there are seventy measuring headings, within this limit there is thirty-eight hundred feet of metal flume in eleven sections. Before this flume was installed it required the services of two and sometimes four men to look after these eleven weak spots.

WATER WORKS AND ITS BEARING ON RATE FIXING

BY C. E. GRUNSKY

(In a consideration for rate fixing of water works, the ratepayer's rights, the owner's demand, and the unlimited life method of procedure call forth most careful attention. Here is an article that discusses all these factors which should prove immensely helpful to engineers throughout the West where these questions have in the past proved so perplexing. The author is a consulting engineer at San Francisco and a well-known writer and authority on the subject of rates.—The Editor.)

If water-works are under consideration the circumstances may be about as follows: The water-works have been long in service. They were originally built by a group of public spirited citizens and operated at a loss. This loss may or may not have been a willing sacrifice offset by the growing value of the real estate in the individual possession of the owners. As the community grew, the water-works grew. The original source of supply may have been wells which had to be abandoned after a time because contamination rendered the water unfit for domestic use. Other near-by sources were brought into use, some retained and others abandoned. The system, as now in use, commands a supply of good water adequate in quantity for some 20 years, with other sources in sight that can be developed at an increasing unit cost. There has been no satisfactory regulation of rates in the past. The original owners have passed out of consideration and the stock of the corporation now owning the property is in the hands of many people, some of whom have acquired it within the last year or two. The bonds which are outstanding,—about $7,000,000—bear interest at 6 per cent and are worth 95 per cent. There is no alternative supply having advantages equal to the developed and prospective sources. There has been no payment for franchises. The acquisition of certain water-rights representing one-fourth of the supply has cost the company $200,000. These water-rights were acquired 10 years ago.

In this instance the books show the cost of construction during the recent years and the cost of the acquisition of some of the lands and rights-of-way, but there is no information available relating to the actual investment covering the entire period of operation nor yet relating to whether the earnings fully amortized the capital which had been invested in the property abandoned from time to time. An investigation is therefore made to verify and to supplement the records of cost and it is found that, including the cost of rights-of-way and the actual cost of water-rights, whether taken from records or approximated, the total actual legitimate capital investment as of the date of the proposed rate regulation is $10,000,000. In this appraisal, market value of real estate is included when its acquisition was not recent and does not appear in the records. Cost and an allowance for the increase of value may in many cases be a good guide in determining at what value it should be introduced as a part of the invested capital. In this valuation of $10,000,000 there are included all properties in use and those held for use within a rather indefinite period of some 20 to 25 years in the future.

If the value of physical elements and the value of the intangibles must be taken into account, as the courts and many of the rate regulating commissions seem to require, it now becomes necessary to approximate the accrued depreciation of the physical elements. This is done by approximating for each class of items or for each item which is of sufficient importance to be individualized, its remaining term of usefulness or expectancy and from depreciation tables for the probable life term new of each class and this life expectancy, the accrued depreciation and the remaining value are found. This tedious, difficult and unsatisfactory proceeding shows for these water-works that the accrued depreciation is $2,000,000.

Going value is now to be appraised. For this there is absolutely no basis because it results from the increment of earnings which is left after deducting operating expenses, current depreciation or, rather, replacement requirements, and interest on the investment. The best judgment of experts is called in, and their chief aim will be to at least offset the accrued depreciation. The result is an allowance of about $2,500,000 for going value.

Now comes the question of water-rights. One-fourth of the water in use has actually cost $200,000 and this amount is included in the $10,000,000 of investment. If one-fourth of the water cost $200,000 and the remainder is equally valuable there should appear in the "value," if itemized, an additional $600,000 for water-rights and perhaps more, because the basis of this calculation is a value which obtained 10 years ago.

The most common practice of the day would, therefore, start with a valuation, being the present or fair value as follows:

Physical elements and actual cost of rights-of-way and of water rights, less accrued depreciation $10,000,000 — $2,000,000 =	$8,000,000
Water rights, value in addition to cost	600,000
Going value	2,500,000
Present value	$11,100,000

It being assumed that this enterprise is in every way legitimate and well managed, the value of the outstanding bonds and their rate of interest can be used as a guide to determine what the rate of return should be on this valuation.

At 95 per cent the 6 per cent bonds net 6.3 per cent. The cost of marketing the bonds was probably at least 1 per cent. It is likely, furthermore, that at the time the bonds were issued the amount realized was less than 95 per cent. It is concluded from such facts as these that the cost of money for this enterprise should be taken at 7 per cent and that of the rate of return on the value of the water-works should be 8 per cent.

Investigation has also been made of the cost of operation and it is found that

Ordinary average annual operating cost including maintenance and repairs is	$400,000
The average annual replacement requirement based on actual experience is	200,000
The estimated current depreciation by sinking fund methods which should have been earned from the beginning is found to be	64,000

In determining the required earnings what allowance shall be made for current depreciation? This

must be settled by those using this procedure with due consideration to the facts in each case. There is no depreciation or replacement fund in this case, consequently there is no interest on such a fund to supplement the estimated current depreciation. The earnings must cover the annual replacement requirements which are best determined by actual experience but which can also be approximated by well known methods of procedure. Using the result of actual experience in this case the required earnings are now estimated as follows:

Required Earnings—	
Operating expenses	$ 400,000
Replacement or depreciation allowance ordinarily estimated but in this case determinable from actual experience at	200,000
Return allowance 8 per cent on $11,100,000	888,000
	$1,488,000

The application of the simple alternative procedure in this case is as follows:

The rate-base is the legitimate investment, $10,000,000. Required Earnings—	
Operating expenses	$ 400,000
Interest 7 per cent on $10,000,000	700,000
Replacement requirement	200,000
Profit allowance 12 per cent of $1,500,000 (approx. gross income)	180,000
	$1,480,000

The one procedure is logical throughout. The other is not. In the alternative the going value and the water-right value are fully covered in the capitalized profit allowance. In connection with the rate-fixing proceeding there is no need of separating these intangibles nor even of inquiring whether if abandoned by the utility the water-right might not have a higher value than a fair division of the profit allowance would give it. The full protection of the investment is secured and the rate-payer is given the satisfaction of knowing that there is a limit set to the profit which the owner of the utility may make in the future. Once the basic valuation has been made, as above set forth, the appreciation of real-estate and other items would be covered in the profit allowance. Additional appreciation would not again be carried into the rate-base, but if appreciating property were at any time in the future released from further public service, its full value, including all appreciation, would go to the owner at that time.

The valuations thus far required by all rate-fixing authorities have been made with careful attention to the smallest details. A standard has been set for the approximation of the cost of reproduction of the plant, to be valued, which would be commendable, except for the fact that the careful estimate of physical value is at once supplemented by the crudest kind of an approximation of intangible values. No basis has been established or found of determining the principal intangible item "going value" and yet an arbitrary allowance for the same, always crudely approximate and at times amounting to or even exceeding the value of the physical elements, is added and given rank and weight with the latter. The sooner such a practice can be modified the better.

What the rate-payer has a right to expect may be summarized as follows:

(a) Good service, the best that conditions permit at reasonable rates.

(b) A share in the unearned increment when general prosperity gives this to the owner of the utility in too large a measure.

(c) A reasonable share, in the course of time, in the benefit which results from any material reduction in operating costs due to the introduction of inventions or new processes which the owner's good management and skill have shown to ve advantageous.

(d) A contribution by the general public toward the maintenance of the utility, which may be secured by a liberal payment for service rendered for commodities furnished to the public or to public institutions or which may be secured by a remission of local taxes in whole or in part.

What the owner should demand is:

(a) Interest on the capital legitimately invested.

(b) An ample allowance for replacements and renewals.

(c) An ample allowance for operating expenses.

(d) Amortization of capital invested in abandoned property.

(e) Compensation for management and for assuming business hazards.

(f) A share in the general prosperity which his utility helps to create.

(g) In the special case of a limited life of the utility or its acquisition by the public, a return of the invested capital.

(h) That amortization of the invested capital be not confounded with accrued depreciation.

What both the rate-payer and the owner are entitled to in addition to the above and what both should demand is:

> The introduction of a method of procedure when rates are to be regulated which will not require an array of valuation experts, to pad a close estimate of physical values with a number of arbitrary intangible values, but which on its face will be intelligible and fair to all concerned.

The items (e) and (f) as enumerated under the owner's demands can best be met as already explained by making an adequate minimum profit allowance based on the annual gross income.

If the rate-payers are few and a reasonable service rate will not fully compensate the owner, then he should be held harmless in the future larger returns.

In the case of the business which has been operating without regulation and which is to be brought under regulation, the present owners should not be made to suffer unnecessarily for the mistakes and improper business methods of their predecessors.

Once the determination of the natural rate-base has been made, the future modifications thereof should be from the book records which should be such as to show at all times the additional capital legitimately invested, the discarded property and its cost, and the condition of the replacement fund, which altter should be just adequate to meet the regular demands upon it for replacements or renewals, and, if desired, also the repairs and generally unkeep expenditures.

The bringing of accrued depreciation into the calculation as though it represented amortization of a part of the investment is absurd; it leads to a complex, unsatisfactory procedure, and compels the use of arbitrary allowances for intangible values which should have no place in a rate-base. All methods of procedure which take account of the accrued depreciа-

tion when rates are to be regulated should be definitely and finally proscribed, and eliminated from consideration.

In December, 1916, a special committee of the American Society of Civil Engineers rendered a repotr on the Valuation of Public Utilities in which they accepted the apparent requirement of the courts, that value be ascertained and made the starting point when rates are to be fixed. The committee strongly advocates the use of a method of procedure which it calls the compound interest method in distinction, from what to many others has appeared as the more logical, the sinking fund method. Under the compound interest method the value, of the physical elements is to be ascertained from time to time, perhaps from year to year, by deducting accrued depreciation, and the allowance for current depreciation of each individualized article is to be a gradually increasing amount, readily computed from original cost, probable life new and age. The committee overlooked some of the difficulties of applying this method to one of which attention may be briefly called. This is apart from the fact that the compound interest method like any other method which pretends to start with value in any form, is illogical and should be condemned. The committee explains how the current depreciation, which they should have called amortization of capital, can be computed or can be taken from tables for any year of the life of an article whose probable life new is known. But the committee fails to point out how to proceed when of a large number of articles, such as locomotives, some fail before their predicted term of usefulness has expired and others survive long beyond this term. Neither the sinking fund method nor the compound interest method takes this non-agreement into account. A mathematical solution has not been attempted by the advocates of these methods. None is possible, as a matter of fact, until the expectancies at various ages for the various articles under consideration shall have been determined with some degree of accuracy. The probable life is merely the average of all available records of service. It is the result of the recorded human experience with all articles of any class. While this probable life new may be predicted with some degree of confidence for many articles, the individual articles of any class will depart widely from the term of life predicted for them as a class. The probable life being a mean of the actual terms of service of numerous articles, there will be among these articles for each one which fails m years before the expiration of its probable term, another which survives m years beyond this term, or two which survive $\frac{m}{2}$ years beyond the term, or three which survive $\frac{m}{3}$ years beyond the term, and so on.

Suppose that a large number of locomotives of a certain type are under consideration, whose probable life new has been correctly estimated at 20 years. For each locomotive which fails and is discarded 10 years before the end of the 20th year after it went into service is reached, there will be one surviving to the end of the 30th year or two surviving to the end of the 25th year or three whose average service beyond the predicted period is 3.33 years and so on.

Introducing 7 per cent into the calculation and following the ordinary erroneous practice, the depreciation (or replacement) allowance for the first year would be in percentage of cost for four locomotives:

Replacement requirement, ordinary allowance (current depreciation) 1st year $4 \times 2.44 \div 4 = 2.44\%$

Compare this with the following illustration of what is bound to take place, though perhaps not at exactly the assumed terms of actual life of the individual locomotives:

If two locomotives fail at 10 years and the other two at 30 years, the allowance for replacement by the sinking fund or compound interest methods of computation which are here under discussion would be:

2 failing at 10 years. $2 \times 7.24 = 14.48\%$
2 failing at 30 years. $2 \times 1.06 = 2.12$

Total, required allowance.....$16.60 \div 4 = 4.15\%$

If one locomotive fails at 5 years, one at 15 years, and two at 30 years:

1 failing at 5 years.....17.39%
1 failing at 15 years..... 3.98
2 failing at 30 years. $2 \times 1.06 = 2.12$

Total, required allowance....$23.49 \div 4 = 5.87\%$

If one fails at 5 years, two at 20 years and one at 35 years:

1 failing at 5 years.....17.39%
2 failing at 20 years. $2 \times 2.44 = 4.88$
1 failing at 35 years..... .72

Total, required allowance....$22.99 \div 4 = 5.75\%$

In each of the illustrative cases the average actual life of the four locomotives will have conformed to the predicted probable life of 20 years, but in each case the allowance which should be made to amortize the capital which goes out of use with the locomotives is larger than that which is predicted on the broad, unwarranted assumption that the probable life of locomotives as a class may be made the basis of the calculation.

Stated generally the following is true:

Let r_m, r_n, etc., represent the replacement requirement computed by Sinking Fund methods for an actual service of n, m, etc., years as the case may be.

Let n represent the probable life in years.
Let m represent any number of years less than n.
Then

$$r_{n-m} - r_m > r_m - r_{n+m}$$

From which, $r_{n-m} + r_{n+m} > 2\,r_n$

Similarly it can be shown that:

$$r_{n-m} + 2\left(r_n + \frac{m}{2}\right) > 3\,r_n$$

and

$$r_{n-m} + 3\left(r_n + \frac{m}{3}\right) > 4\,r_n$$

This means that the amortization or replacement allowance for two or more articles having different terms of usefulness should always be larger than the allowances for the same articles if they be assumed to fail altogether at the average of the individual terms. The amortization or replacement if estimated from the probable life new of any article will be too small.

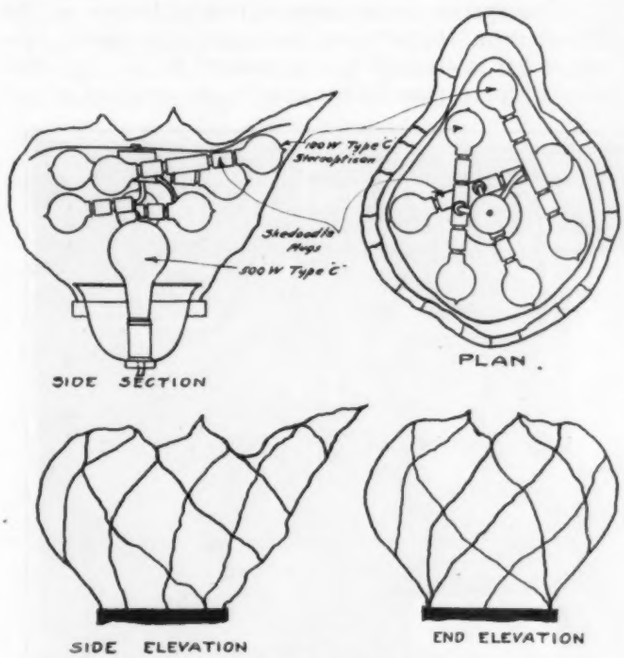
In the practical application of this fact the valuation engineer when called upon to determine how much should be in a replacement fund or how much capital should have been amortized out of the ascertained earnings, will always find himself in trouble. How he will get out of it depends upon the circumstances in each case.

There is some satisfaction in knowing that these and other like difficulties can be avoided in the regulation of rates, if the valuation authorities will have the courage, as they have the right, to adopt some method of procedure under which accrued depreciation need not be estimated. The writer has intimated what this procedure should be and he has fully described it in the various publications already referred to. It need only be stated here that he has named it, the Unlimited Life method, that its correctness is unquestioned, that it does not involve any estimate of accrued depreciation and that the current replacement requirement does not have to be ascertained with more than a fair degree of approximation.

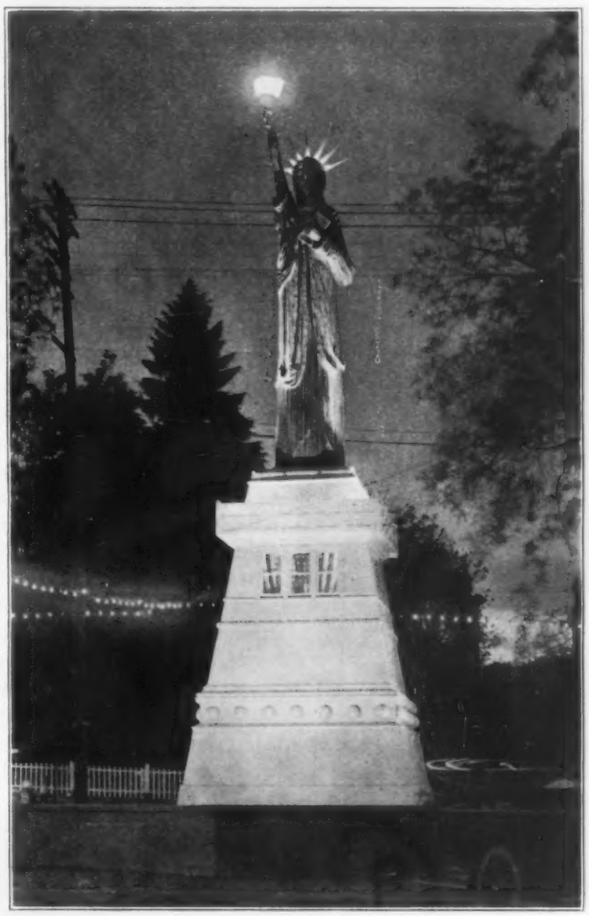
A NEW ELECTRICAL FEATURE OF PORTLAND ROSE CARNIVAL

For the past eleven years the Portland Rose Carnival has been an annual event supported by voluntary subscriptions, principally from the citizens of Portland. These subscriptions became a burden on a few and as the carnival had the hearty support of all the taxpayers in the city, a bill was passed by the last legislature providing for the organization, maintenance and support of Rose Festivals in any county in which there is more than 75,000 inhabitants. The Rose Festival fund must be raised by taxation not to exceed 1/15 of one mill. The county commissioners have complete charge of the funds so raised.

The carnival lasted only three days this year—June 13 to 15, inclusive. Mr. A. C. McMicken, commercial manager for the Portland Railway, Light & Power Company, had charge of the decorations. In the Court of Patriotism there was erected a statue of Liberty, which was constructed by P. L. Fraglio, the total cost erected being about $2000. This statue was an exact replica of the Statue of Liberty in New York Harbor. The overall height of the statue from bottom of tower to top of torch flame was approximately forty-five feet, built in true proportions. The tower was constructed of "staff" and beaver board built over a strong frame structure. The flame of the torch was constructed of art glass colored to imitate a torch flame. The glass parts were so fastened together as to withstand wind pressure and the high temperature of the lamps used to illuminate the flame. There was also a cover for the torch flame so as to protect the lamps from the weather, at the same time permitting light to be thrown up to the top of the flame.



INGENIOUS LIGHT ARRANGEMENT FOR ILLUMINATION OF STATUE OF LIBERTY



THE STATUE OF LIBERTY AT PORTLAND

Here is how the citizens of Portland recently improvised an exact model of the Statue of Liberty in New York Harbor. This beautiful piece of workmanship was then artistically lighted by means of the latest ideas in evolution of illumination engineering. The entire effect served to give the Portland Rose Carnival a tingue of the method electrical that will not soon be forgotten.

This Statue of Liberty effect was only one of many beautiful electrical features that were made possible through the illuminating engineering department of the Portland, Railway, Light & Power Company.

A RADIO STATION IN SALVADOR

BY J. W. FINCH

(Here is a technical description of a recent installation of a radio station in Salvador that has been made by the courtesy of the Mexican government through Mr. Luis Sanchez, the engineer in charge of construction acting under the Director of Telegraphs in Mexico. The article illustrates the immense forward strides that are being made among our foreign neighbors to the south and should be read with widespread interest. The author is a representative of the Journal of Electricity who is making an extended survey of engineering and technical matters among our Latin American neighbors. Since he has had a wide experience in hydroelectric construction in California, he speaks with unusual emphasis for engineers throughout the West.—The Editor.)

Triangular Radio Tower in Salvador

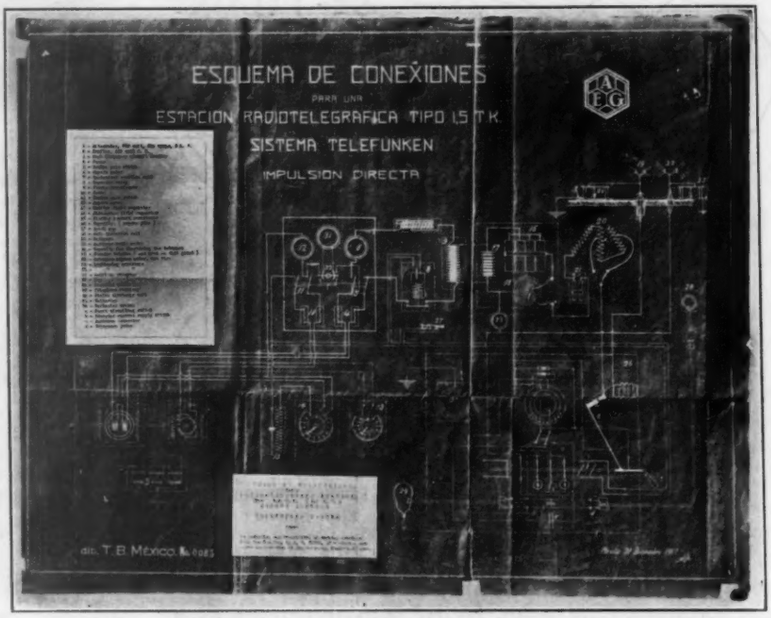
SALVADOR, the smallest of the Central American Republics and at the same time the most densely populated, with its 1,700,000 people occupies an area of but 7,225 square miles. An average of 325 inhabitants per square mile. The country is charming in its scenic variety and offers unusual interest in its seashore, interior lakes, cultivated valleys and wooded mountains. The building and maintenance of good roads is being given considerable attention by the National Government due very probably to the increasing number of automobiles in the country. The Government owned telephone and telegraph system which extends throughout the republic is quite complete and efficient and offers connection by land wire with Guatemala on the north and Honduras on the south and east. Telegraphic connection with the United States and the world in general is over the cables of the Central and South American Telegraph Company.

Not many months ago considerable interest was exhibited by the press of the United States, in a wireless station which was reported to be under construction in Salvador. Many conjectures were offered at the time and more or less sensational statements were made as to the capacity and radius of the plant, and too, there seemed to be a great mystery as to its ownership. The writer remembers reading an account in one of our spectacular dailies in which it was stated that "this powerful plant, the property of the German Government," was in daily communication with the German Empire.

Seeing the towers of this station when entering the city of San Salvador prompted an investigation and through the courtesy of Senor Don Luis Sanchez, Inspector del Sistema Radio-Telegrafico of the Republic of Mexico, who is Director in Charge of Construction of the still uncompleted plant, the writer was permitted to visit the plant and take some notes of the equipment. While the towers and the aerial system are complete and all apparatus is on the site, it will be probably two months from the date this article is written before the plant will be ready for operation.

The system is of German manufacture, the complete apparatus having been graciously presented by the Mexican Government to the Republic of Salvador, agreeing to supply the complete equipment and loan their constructing engineers to supervise the erection if the Salvadoreno Government would furnish the site and erect the necessary buildings. With the fine courtesy of the Latin American the apparent sole object of the gift was to still further cement the already very friendly relations existing between these two countries. What further significance there was, or is, in the transaction, if indeed there is any, is best left to the reader's conjectures.

The system under construction is known as the "Telefunken," harmonious extinguishable spark system and it is claimed by the makers to give an efficiency of more than 50 per cent in the relation of pri-



CONNECTIONS FOR RADIO STATION

Here is a diagram of connections for the splendid new wireless system in Salvador, the gift of the Mexican Government. The system is of the harmonious extinguisher type and is claimed to give an efficiency of more than fifty per cent in the relation of the primary current to oscillating current at the antennae. The tower is 60 meters high.

mary alternating current to oscillating current at the antennae. One of the features of the system, with which many American Engineers are no doubt familiar, is claimed to be the arrangement of the spark gap electrodes in which the spark is divided and in which each spark impulse is completely extinguished after a half oscillation of the condenser circuit. Reference to the connection diagram which is reproduced herewith indicates at 17 a series of metal discs which form the spark gap. The regulation of the length of spark required and at the same time the energy consumed is affected by short circuiting the discs, using one disc only for a short transmission and adding discs as required until all are in play for the maximum distance for which the plant is designed. The energy flowing in a reverse direction of the secondary circuit of the antennae to the primary of the transmitter prevents the formation of two different wave lengths.

The arrangement of the spark gap discs precludes the possibility or at least lessens the tendency of the spark to form arcs and facilitates a rapid succession of sparks in the transmitter. With from 500 to 2000 impulses per second in the receptor, a sound is produced which is a pleasing musical tone and it is claimed thereby all foreign noises are completely shut out.

The plant is located in the city proper of San Salvador, but well out from the center of town. Current is therefore available from the lines of the local lighting company, La Compania de Tlumbrado Electrico, and is supplied at 220 volts, 3-phase. A motor generator set is employed consisting of 10 h.p., 220-v., 3-phase, 60-cycle, 1800 maximum r.p.m. variable speed, a.c. motor, belted to a 5 kw., 220-v., single phase, 500-cycle, 1800 r.p.m, a.c. generator. In order to obtain the desired tone the number of alternations is variable between the limits of 480 to 650 per second, by regulating the number of revolutions of the motor generator set. To regulate the excitation of the generator and the number of sparks per second, a resistance is employed by means of which is determined the height and capacity of the tone obtained. A 10 h.p. Otto Gas Engine is installed as an auxiliary to the a.c. motor, so that power is available at all times. The engine is equipped to burn petroleum or the lower grades of distillates and it is so arranged that it can be connected very quickly with the generator in case of an interruption to the city current supply.

The transmitter current passes from the generator through an oil immersed transformer where it is transformed from 220 volts to 8000 volts. In the primary circuit of this transformer is connected a reactance coil which serves to effect the resonance between the transformer and the excitation circuit. The excitation circuit is composed of 4 Leyden jars having a capacity of 10,000 c.m., the spark gap consisting of 12 parts or discs and an auto-induction that consists of a spiral band of copper, from which is taken various taps, provides a means of varying the oscillations of the circuit within certain limits.

The station is designed for syntonization for wave lengths of 600, 900, 1200, 1650, and 2000 mt. To syntonize the antennae with the excitation circuit a mechanism is provided for figuratively lengthening the antennae. This apparatus consists of five spiral coils mounted in a fixed position on a shaft. Taps are provided so that any number of coils can be connected to the antennae and in that way obtain the desired wave length.

The antennae of this plant is of the common T shape and has a capacity of 2000 c.m. It is suspended between two triangular steel masts each 60 mt. in height and 100 mt. apart. An unusual feature of the mast construction is the fact that the mast is effectively insulated from the ground by means of a large built up glass insulator at its base, as shown in the accompanying cut. Each steel tower weighs in itself over seven tons and adding to that weight the pull of the 8 guys consisting of one inch steel rods, the weight of a tower on the insulator is probably 25 tons. The guys are also insulated, having glass discs set in a turn-buckle near their lower end. A lightning arrester is shown in the photograph also with its adjustable gap and disconnecting switch.

The receptor is arranged with several telephone circuits so that more than one person may receive at the same time, and its range is for wave lengths from 220 to 4000 mt. The transmission range of the plant under favorable atmospheric conditions is, during the day 450 kilometers and during the night up to 1000 kilometers, these distances being possible for free sea transmission including not more than 10 per cent of clear land. For land transmission the distance is considerably less as the vegetation here is very dense and there is heavily wooded territory to pass, on practically all land sides. The land distance during the day is 400 kilometers and during the night up to 700 kilometers. Under exceptionally favorable atmospheric conditions perhaps any of the distances mentioned could be increased a little but for all practical purposes they indicate the limits of the plant.

Huge Glass Insulator at Base of Tower

Government Nitrate Plants to Be Rushed.—Secretary of War Baker has made brief announcement that Government plants for the electrical fixation of atmospheric nitrogen are to be erected and placed in operation at the earliest possible date. It is expected to spend about $4,000,000 for this purpose out of a total appropriation by Congress of $20,000,000. Mr. Baker stated that the plans now being worked on would not involve new water-power developments on account of the length of time required for the erection of hydroelectric plants.

CONCLUSIONS ON HEAT INSULATING MATERIALS

BY JOHN CRAWFORD, Jr.

(Electric water heating constantly demands an increasingly closer attention to the materials used in heat insulation. Here is an article that concludes a valuable series of three papers on this subject that have appeared in the issues of the Journal of Electricity for July 15, 1917 and Aug. 1, 1917. In this article the author, who is head of the asbestos and magnesia department of the H. W. Johns-Manville Company at San Francisco, concludes his treatment of this subject by a discussion of the efficiency of a number of commercial insulation materials on the market. A table of thermal conductions of various insulation materials together with a valuable bibliography on the subject of heat insulation is appended, and finally follows the stenographic report on the subject of heat insulation that took place at the Riverside Convention of the Pacific Coast Section, N. E. L. A.—The Editor.)

The endeavor of the foregoing paper has been to clearly point out that to maintain in an uninsulated or inefficiently insulated condition any hot surface from which the heat loss represents a loss of fuel or decreased efficiency, is a wasteful extravagance.

The use of insulation which is not properly designed, or so proportioned in thickness as to give maximum economical return on investment, is not excusable, in this day when all necessary data to guide one, is available. In general, the insulating efficiency of the various commercial non-conducting materials increases in more than direct ratio to their increase in cost. Hence, the purchase of the cheaper types of commercial insulation is false economy from two standpoints. First, because of their lower insulating value, and second, because usually the design of cheaper forms of insulation is such that they have not the durability of the more efficient types—i.e. their initial insulating value cannot be considered as being permanent.

In traveling from one point to another, heat, like electricity, chooses the path of least resistance to its flow. Since confined air offers the highest resistance to heat flow, manufacturers endeavor to take advantage of this fact in designing heat insulation. How permenently efficient the resulting insulation really is, depends:

First: On how closely the air is confined to avoid losses by convection.

Second: On how poor a conductor of heat the material confining the air is.

Third: On whether the flow of heat must cross the confined air or if the greater part of the flow is around it. In the latter case the efficiency of the insulation depends on how devious this path is.

Fourth: On whether continuous expansion, contraction and vibration of the surface on which the insulation is applied will gradually cause the insulation to crack or revert to a powder on the inner surface, thus facilitating convection currents between the hot surface and the insulation.

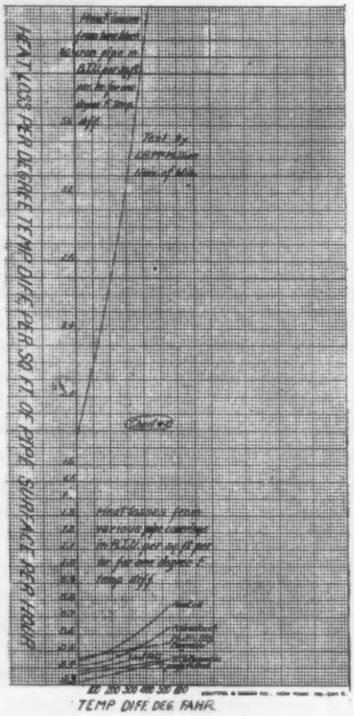


Chart No. 2. The Heat Loss from Bare Black, Iron Pipe in B.t.u. per Sq. Ft. per Hr.

Fifth: Whether the chemical composition of the insulating material is such as to be affected by long continued action of heat.

Chart No. 2[1] which is one of the most valuable recent contributions on heat insulation gives for a temperature difference range up to 700° F., the heat loss from bare, black, iron pipe in B.t.u. per square foot per hour, for each degree F. temperature difference between steam and air and the heat loss from the pipe when insulated with 1-inch of various types[2] of commercial pipe insulation. These tests were made on a standard 5-inch pipe. Hence, the results are not strictly accurate for pipe insulations greatly larger or smaller, but as 5-inch is about an average size of the piping in any plant, the errors will tend to compensate each other.

A survey of this chart indicates how rapidly the heat lost from bare pipe increases as the temperature difference becomes greater. As has been previously pointed out, the heat transferred by radiation from the surface of the pipe and by the convection currents of air surrounding the pipe increases in geometrical ratio to the difference in temperature. The thermal conductivity of the steel itself also becomes greater as its temperature increases.

Now let us consider the six typical forms of high temperature insulation in order.

The insulating value of air cell is very poor, even at low temperatures, and its relative insulating value decreases as the temperature differences becomes greater. This is because its structure of longitudinal channels of poorly confined air facilitates losses by convection currents.

In asbestocel insulation, the channels of air run transversely and are much smaller than in air cell. Hence, its insulating efficiency is much higher at all temperatures. But, since the air which it encloses is free to circulate, there are appreciable convection losses through the two longitudinal cuts in the covering. The curve shows that like air cell these convection losses become greater as the temperature difference increases.

The plastic magnesia curve does not indicate any loss by convection. The losses are greater than in magnesia pipe covering because, as applied in plastic

[1] Abstracted from "Heat Insulating Properties of Commercial Steam Pipe Coverings" L. B. McMillan (Trans. A. S. M. E, Dec., 1915.)

[2] McMillan also tested many other makes of coverings of these types.

form, magnesia is denser and contains less confined air, and because, in drying out rapidly on a steam pipe, it shrinks, and is traversed by small cracks.

The heat retarding principles taken advantage of in wool-felt are technically correct. The structure of the felt is such as to cause the heat travel by conduction to follow a circuitous path and between each layer of felt there is a film of air, across which the heat is forced to travel. Wool felt shows no convection losses. That it does not show higher efficiency

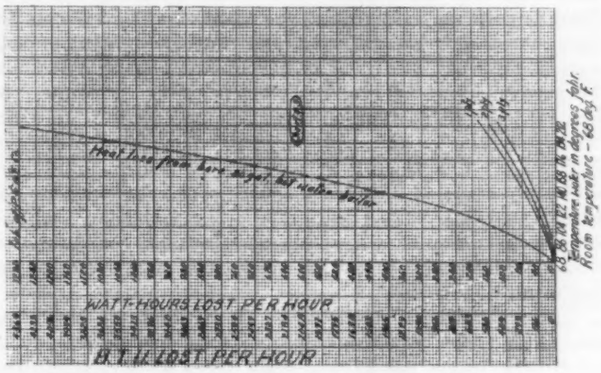


Chart No. 3. B.t.u. Loss per Hour for Domestic Hot Water Tanks from a 30 gal. Tank Insulated with an Economy Jacket

is because ordinarily there are only about twenty layers of felt used to the inch—with twenty intervening films of air. As wood felt is organic material, its use is limited to low temperatures.

The efficiency of 85 per cent magnesia insulation is due to the fact that hydrated carbonate of bagnesia ($4MgCO_3MgO_2H_2 \times 5H_2O$) contains per unit of volume a very large proportion of air confined in very small particles, and to the fact that the material itself is a very poor conductor of heat. The easier path for the heat flow is by conduction through the magnesium carbonate and around the air pockets. Hence, the greater amount of the heat flow will be in this way. To escape thus, the heat must travel a long circuitous path. The limiting factor to the efficient use of 85 per cent magnesia pipe covering is the fact that its high initial insulating value cannot be considered to be permanent at high temperatures. From its composition, it will be noted that it consists of carbonate and hydrate of magnesia with a relatively large proportion of chemically combined water. This chemically combined water will be driven off quite rapidly at 500° F. and more slowly at lower temperatures. This breaking down in structure will be augmented by expansion and vibration of the hot surface, and a channel of unconfined air will be formed between the hot surface and the insulation. Heat losses by convection will result.

As the chart indicates, asbesto-sponge felted has the highest efficiency of any commercial insulation. Since its design takes into consideration the laws of heat flow in the most technically correct manner, it is logical that it should be. Asbesto-sponge felted insulation is composed of 40 sheets to the inch of a loosely felted asbestos material in which are incorporated fine particles of ground sponge. Both asbestos fibre and sponge are very poor conductors of heat and by making them into a loose felt, a large amount of confined air is enclosed. This causes the flow of heat to follow a devious path through the felt. Between each two layers of this felt is a film of confined air, which is the slowest conductor of heat known. In the case of these films of air there is no path for the heat flow to get around them, hence, it must pass across them. As there are forty of these films of air to each inch, it will be apparent that the rate of heat flow will be enormously retarded thereby.

Since asbestos does not lose its water of composition below 1000° F. and since the percentage of the organic matter (sponge) is small, asbesto-sponge felted insulation can be considered to be permanently efficient at the highest temperatures of superheated steam.

Charts Nos. 3 and 4 refer particularly to the insulation of domestic hot water tanks. Where gas or electricity is used as the source of heat, the economic efficiency of the insulation used to retard the heat losses from the tank is generally the limiting factor which determines the success or failure of the installation. But, even where cheap forms of fuel are used the domestic enjoyment of always having an abundant supply of hot water more than compensates for the investment.

The economy range boiler jackets which use as their insulating medium hair felt, are highly efficient, easily applied and moderate in price.

Sil-O-Cel is a good insulating medium per se but its use is limited to conditions where it is feasible to build a box around the boiler to contain it.

Obviously, the proper heat insulation to use is that which will give the highest permanent return after the initial investment has been amortized, and the author trusts the foregoing paper may be of some assistance in making the proper selection.

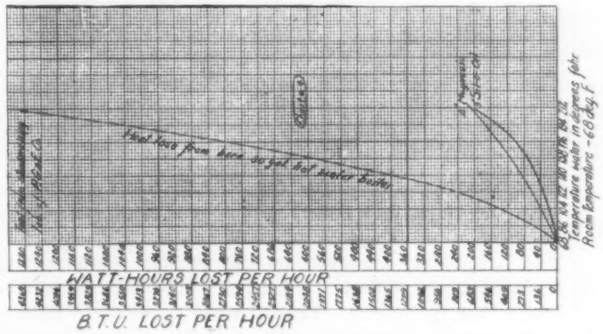


Chart No. 4. B.t.u. Loss per Hour for Domestic Hot Water Tanks from a 30 gal. Tank Insulated with Magnesia and Sil-o-cel

Thermal Conductivity of Insulating Materials

(C. P. Randolph, Research Laboratory, General Electric Co., Great Barring, Mass., 1913.)

Material	Weight, lb. per cu. ft. as Tested	Thermal Conductance per sq. ft. per in. thick, per hr., per Degree F. Diff.
Dead air	.06-.08	0.191 B.t.u.
Asbesto-sponge felt	34.40	0.33 "
Cattle hair felt	8.49	0.345 "
85% magnesia blocks	13.50	0.455 "
Mineral wool	26.60	0.479 "
Diatomaceous earth and asbestos	20.7	0.526 "
Pure loose asbestos	12.5	0.546 "
Asbestos corrugated paper	15.6	0.693 "

(By Union Pacific Railroad, for Standard Car Committee, Omaha, 1914)

Cattle hair felt	10.53	0.251 B.t.u.
Pure cork board	14.98	0.274 "
Lith	24.50	0.305 "
85% magnesia	25.53	0.331 "

(By C. P. Paulding, 1910)

Cattle hair felt	0.32	B.t.u.
Mineral wool	0.38-0.47	"
Pure sheet cork	0.47	"

(Miscellaneous Authentic Sources)

Hair felt	0.40	B.t.u.
Sheet cork	0.50	"

Efficiencies of Different Sectional Insulations at Various Temperatures

(Tested on 5-inch Standard Pipe by Prof. L. B. McMillan)

Kind of Covering	Temp. Dif. Deg. F.				
	100	200	300	400	500
Asbesto-sponge felted	83.8	86.2	88.0	89.8	91.5
85% magnesia (A)	82.3	85.0	87.3	89.4	91.4
85% magnesia (B)	80.5	84.1	86.6	88.8	90.9
Diatomaceous earth and asbestos	81.3	84.6	86.9	89.0	91.0
Asbestocel	80.0	83.0	84.8	86.5	88.2
Serrated	78.2	81.0	83.3	85.4	87.8
Air cell (A)	77.9	80.7	82.7	84.1	85.8
Air cell (B)	75.0	78.3	79.1	80.9	83.1
Wool felt (A)	81.4	84.2	86.4	....	....
Wool felt (B)	80.9	83.8	85.9	....	....
Plastic 85% magnesia	78.2	81.6	84.5	87.1	89.5
Fire felt	67.0	71.9	75.6	79.0	82.6
Vitribestos	69.6	73.2	76.0	78.8	81.4

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ERRATA: In the issue of the Journal of Electricity for Aug. 1, 1917, a typographical error appeared in the closing paragraph of the article on Types of Practical Heat Insulation by John Crawford, Jr., on page 116. The paragraph should read:

The list price of 2-inch thick Asbesto-Sponge Felt Sectional Insulation for 12-inch pipe is $2.70 per lineal foot and for 1-inch thick $1.85. The increased cost of using 2-inch thick insulation over 1-inch thick is therefor 85c per lineal foot. The increased fuel saving is 0.007 lbs. of oil per foot per hour.

Assuming oil to be worth $1.25 per bbl. of 336 lbs. or $0.0038 per lb., the increased fuel saving per hour is $0.0000266 per lineal foot. Hence, to pay for the difference in cost between 2-inch thick and 1-inch thick insulation, it will take

$$\frac{\$0.85}{\$0.0000266} = 30195 \text{ hours} = 41 \text{ months.}$$

Since the additional investment is amortized in 3½ years by the increased saving, the economy of using the thicker insulation is apparent.

RIVERSIDE DISCUSSION ON HEAT INSULATION

John Crawford, Jr.: I have prepared a brief synopsis of the subject.

The impression conveyed by the various speakers who have preceded me is that you all have one ultimate aim in view, and that is Service. You all seem to want to give to your consumer the greatest number of B.t.u's. for the least possible price and still be able to make a profit for yourselves which is commensurate with your investment and which justifies you in taking the business and in giving the consumer those B.t.u's. One of the best ways of accomplishing this is to conserve for the consumer the greatest possible number of those B.t.u.'s. for the service for which they are intended.

I really believe it will be distinctly to the advantage of you men to make a serious study of heat insulation. For instance, you should know, if you do not already know, why it is that if you put 1 in. of a particular form of insulation that I have in mind on a 1 in. pipe carrying steam at 150 lb. pressure, it will show a heat saving of approximately 80 per cent of the heat which would be lost from the uncovered pipe and if you put 1 in. of the same insulation on a 12 in. pipe, it would show a heat saving efficiency of almost 89 per cent. I believe you should also know that the cost of insulating with that particular form of insulation per square foot of surface on a 1 in. pipe is approximately 79c, and on a 12 in. pipe only 55c. You should know that the basis on which the value of heat insulation should be computed is really not per square foot of radiation surface but per unit of internal heat volume. That is, after all, what you are trying to do to conserve a certain volume of heat in the hot water tank. Manifestly, the greater the volume you can get for any given square foot of radiation surface, the more efficiently you can insulate it. These points do not seem to have been given the consideration they deserve and the fault, I believe, is not with the engineering profession. To a great extent, the fault lies with the manufacturers of non-conducting materials. They have made extravagant and unsubstantiated claims for their non-conducting materials and they have failed to indicate under what conditions of service their materials should be used to give the greatest efficiency. For example, you can take a specific type of insulation and apply it to a hot water line and it will show you, say 85 per cent efficiency. If you apply that same type of insulation under another condition of service it may show you 80 per cent efficiency, or it may show you 90 per cent. For every particular condition of service there is a type and a thickness of insulation which will show the highest permanent return on the investment.

In conclusion, I simply want to say that for insulating hot water tanks, which is what we have had principally in mind here, today, you have at least three distinct conditions to consider.

First: It would seem you want a h'gh heat insulating efficiency.

Second: You want a type of insulation that will show maximum efficiency for the thickness of insulation used when applied by the same mechanic who installs the electric heater.

Third: It would seem to me you want a type of insulation which can be shipped in a convenient package, all in one piece. This seems to be especially true where electric heaters are shipped out into country districts.

Chairman S. V. Walton: Mr. Crawford has prepared this treatise on the subject and has made a number of copies. I want to speak for one of the copies myself. We can have it printed in the record, if you will turn it over to the secretary. There is one other man in the room that I promised to call on to speak from the same general point of view—insulation and water heating in general—Mr. Morris of the Westinghouse Electric & Manufacturing Company of Los Angeles, who has had considerable experience on that subject.

J. M. Morris: Gentlemen, Mr. Crawford has covered the ground in his remarks, but I want to emphasize an important detail in connection with the art of heating water by electricity. Efficiency is necessary. There are two kinds of heater. in one case the element is in the tank. The other is a circulation type. It is an instantaneous heater and is exterior to the tank. In my study the heater itself should be lagged. I notice that in all cases where the circulation pipe is on the outside of the tank, the heater is out in the open. The temperature of the heater is very high and the radiation is considerable. There are some types on the market that take care of that by putting the heater within the lagging. I think that ought to be considered carefully in connection with this water situation when you realize at 2 cents the cost per gal. is a quarter of a cent for hot water, and that the consumption of a family of about four people, that is, two grown people and two children, is apt to run approximately thirty gallons a day, in cases where they do their own washing, or between 900 and 1200 gallons per month. You must realize this lagging question is a most important one.

Chairman: I might mention the tests made in our laboratory which indicate that under the ordinary conditions the losses in the heater,—approximately 8 ft. of circulation pipe —the losses were approximately 50 per cent as great as the losses in the entire boiler itself, showing the necessity of covering up the heater and saving that heat.

THE PLOT IN ADVERTISING

BY H. A. LEMMON

(Here is an excellent article on the plot that must underlie successful advertising matter sent out to set forth in the local papers the usefulness that electricity and electrical appliances have for the household. Mr. Lemmon is salesmanager for the Reno Light & Power Company of Nevada and is a well-known figure in the upbuilding of the electrical industry in the West. The paper was delivered at the recent Santa Cruz Convention of the California Association of Electrical Contractors & Dealers. In this article the psychology of advertising is set forth while in the next issue of the Journal an extremely useful chart for applying the psychological principle will be given.—The Editor.)

I conducted a toaster campaign—not so many years ago—in which I used large space in the daily papers, showing beautiful pictures of the device, and gave many scientific reasons why electrically made toast was superior to others—as in fact it is. Much of that advertising copy was prepared by one of the highest paid advertising experts in the United States, and was elaborately decorated with such cleverly descriptive words as "crunchy," "dainty crispness," "golden brown," "delicate flavor," etc., until as I read it over and planned the other details of my campaign my mouth would water and I had to wear a napkin in my office to save the desk pad. I soon realized that my supply of toasters would never survive the first ad, and so wired a rush order for another 100. Just my natural conservatism kept me from making it 200. I convinced the manager that if he would keep his hands off I would show him something, and opened up with half-page spreads. Well, when the ten-day advertising campaign was concluded we had sold about twenty toasters for $3.50 each and the advertising expense was exactly $27.80 per toaster. It seemed to occur to me that advertising doesn't pay.

A few weeks later I tried it from a different angle and sold close to 100 toasters at an advertising expense of 32 cents each. Apparently advertising does pay—sometimes.

But to go back to the first campaign. It dawned upon me that this little matter of advertising was worth looking into if I expected to remain "among those present" on the pay-roll. The first obstacles encountered were the theories of some of my friends who are professional ad writers. They told me no one could foretell the result from any certain series of retail advertisements. They've told you the same thing until perhaps you believe it. Some of them will prove it if you let them write the ads. The next time any ad man tells you that sand-bag him and while seated on his chest tell him gently but firmly that any such uncertainty in result is due to the writer of the ad, and to him only. If you tell him that there should be no more difficulty in approximating the cash returns from any given series of advertisements for our goods than the United Cigar Company has in determining in advance the probable sales of a new store, he is going to look into your eyes to see if you really mean it, and finding you do is likely to edge off to a place of safety and probably report you to the first policeman he meets.

And yet I stand here a stranger and unarmed and assert to you that you can do exactly that thing; and further

That any one of you can write as good a retail advertisement as can the expert—with a fair chance that it will be better; and still further

That retail advertising is not an art. It is not a mystery. It is an exact science, based upon very simple rules.

THE PSYCHOLOGY OF SALESMANSHIP

"If you wish to sell to me an article for my own use that every day necessity doesn't demand, you must lead me to form a picture in my mind in which I and the article itself form the principal parts, and the picture must be one in which I seem to be deriving great benefit and pleasure from possession of the article."

Advertising may be used to accomplish so many purposes that a consideration of them all would occupy the entire time of this convention. For example there is the one of creating good will. Some advertisements are designed to mold or change public opinion, and so on; but we will confine ourselves to retailing electrical goods. And please bear in mind all the while that for many years the world jogged along very comfortably without the electric devices we so very much wish to see introduced into every household. Therefor insofar as advertising them is concerned we will do well to treat them somewhat as we would luxuries, however cleverly we may conceal such treasonable thoughts.

What usually happens when one of us starts to write an advertisement to sell electric ranges, for example? Most of us will look through a collection of the manufacturers' booklets and endeavor to include all the points of excellence we find there. In other words we try to sell electric ranges.

Now it so happens that there isn't anyone in our whole world who wants to buy an electric range. And there are hundreds—perhaps thousands of women in my territory who are suffering for better cooking methods. That is they are longing—perhaps unconsciously—for some of the things an electric range will give them. So instead of trying to sell them electric ranges we will sell them some of the things an electric range will accomplish, and we will write and talk very little about the range itself and a great deal about these things.

Fortunately advertising is one of the very few undertakings of which perhaps we can tell what to do, easier than what not to do.

Advertising to men or women familiar with, and already interested in an article is one thing; interesting them in an article with which they are more or less unfamiliar, and don't believe they need, is another. Advertising to purchasing agents, engineers, central stations, contractors and dealers is advertis-

ing the article itself. That is the manufacturer of a device, which he wishes you to handle, usually devotes his space to making you acquainted with it from the standpoint of its reliability, its novelty, its saleability, etc. He speaks much of the article itself.

Having stocked it and desiring to sell it rapidly we likewise contract for newspaper space and tell the people about it. But our method should be far different from that of the manufacturer. While he dwells upon the mechanical perfection of his suction cleaner, for example, with a paragraph or more about its motor, and another about its fan, etc., in his endeavor to sell to us; we exactly reverse his methods—that is if our advertising is to give profitable returns. We tell the people little or nothing about the device itself and a great deal about what it will do for them in their hands and in their homes. In other words we purchase a device, but sell a service. If we can remember just that one point we will have laid the foundation for a successful advertising or selling campaign, and almost instantly have become expert retail salesmen.

It isn't necessary for you to tell me that I am no brighter than you are. I admit it; and so I am going to tell you how I escaped the conclusion that advertising doesn't pay, and also managed to keep a clutch on that job.

After the tragic returns of that toaster campaign were all in I spent some two or three sleepless nights deciding on just the form of resignation I should send in and speculating as to whether I would be allowed to present it before being fired.

Of course my wife noticed this despondency and commented on it and endeavored to learn its cause. I finally informed her—just in the manner you would go home and tell your wife you had been caught stealing the neighbor's lawn mower. Incidentally we had a small boy in our house. Wife was very sympathetic over that toaster campaign failure of course. It was a shame, but the boy had gotten a hundred in spelling and 95 in language and 90 in school deportment and wasn't it just wonderful.

I remarked that quite possibly our boy would have to leave school and get a job as messenger or something of that sort to keep the wolf from chewing off the doorknobs.

"Uh, huh," and if our boy acted like that Jones boy next door she would spank him until he never would want to sit down again. Well, it was unusual, but I really did have a thought. I learned something that every one of you always knew; that the female of the species'—any species—first thought and deepest interest is for her offspring. That to a normal mother her children are about all in the world that iis really essential and almost everything else is just ornamental, or incidental as it were. Of course I always knew that also—just didn't have wit enough to cash in on it. Reach the mother through her heart interest. Likewise it eventually penetrated that most of the ladies to whom we can sell are mothers. Those who are not have other interests nearly as useful to us for our purposes.

So I went to work jotting down reasons why various women should be considered eligible prospects for electrical devices. I soon found that a surprisingly small number of words included every probable buying motive—just as many have found before. The next thing learned was that these same reasons for purchasing applied to any article which might be offered for sale. Also that all of the ladies of my acquaintance could be classified into extremely few groups and pretty soon a chart suggested itself.

What is necessary to accomplish a sale? Just one thing. If you wish to sell to me an article for my own use that every day necessity doesn't demand, you must lead me to form a picture in my mind in which I and the article itself form the principal parts, and the picture must be one in which I seem to be deriving great benefit and pleasure from possession of the article.

The second toaster campaign dismissed the device itself and the fact that it made toast in one sentence; and instead sought the appeal in other sources. First, ostensibly in the little daughter of the household. She could make toast for daddy at the breakfast table. The idea pleases the little girl, and a little girl is an influential member of any household. Every father is proud and happy to have his little daughter take on grown-up duties when they are expressly and exclusively for him. He is likely to boast of it if anyone will listen to him. So it works both ways. Another ad of this series was for the mother. Her little girl could share the responsibility of preparing the breakfast. Also a double purpose—as you will observe.

I wish particularly to call your attention to the difference in the two campaigns, for I wish to speak of the principles underlying this one a little later on. The appeal to the father, mother, and daughter herself, was a story with a plot. The advertisements regarding the excellency of the toast, the rapidity and beauty of the toaster had no plot. The stage was all set, but we didn't bring in the actors. It consisted of nothing but scenery. A story without a plot isn't much of a story. Neither is an advertisement without a plot much of an advertisement.

That plot we are talking about is for nothing more or less than to create a mental picture. No plot, no picture. No picture, no sale.

There isn't a man attending this convention who wants to buy a doll right this minute, and probably not one who would buy if I offered some for sale. It quite likely wouldn't increase my selling chances any if I explained to you that my dolls had real eyelashes, or real hair, and moving arms and could cry; but if I had the power of words to force you to paint a picture in your own minds of the joy and the pleasure—the widening eyes—that would come to some little girl of your acquaintance, every man of you would buy one of my dolls, because the mental picture you would have formed of the happiness given to that little girl constitutes a real selling plot.

However if you were little girls, instead of men, I would have only to mention the word "dolls" and every little feminine mind of you would immediately furnish its own picture out of the abundance of its imagination and would weave around each of the specifications of real eye-lashes, movable limbs and so

forth, a veritable fairy plot. So we see that plot building in our advertising must consider the view point of the one to whom we are making plea. Undoubtedly some advertisements without plots sell good such as we are interested in, because some of our readers are imaginative enough to paint their own mental picture without our suggestions, just as do little girls when they see the word dolls. But grown-up people are not generally imaginative to any degree in the ordinary affairs of life.

Another illustration. If one of you is suffering the excruciating pain of a good healthy corn between two toes—a non-union corn that revels in long hours, a corn that is enthusiastic and stays on the job—all that is necessary to gain your closest attention is the word "corns." Your own imagination and experience supply the plot. Yet if we were advertising a preventative of corns and wished to reach the man with healthy feet the word wouldn't impress itself upon his mind to any extent whatever, and even though it might appear in large type in a choice position in his favorite paper he probably would not be conscious of having seen it. In the latter case we would have to write to stimulate his imagination until his mind pictured the plot—the agony of a corn—and he would be aroused thereby to spend money and take time to guard against something which we will have taught him is painful.

Still another: Whichever way we turn we are confronted by the cryptogram "57." We don't require anyone to tell us that it refers to a famous manufacturer's pickle products. Standing by itself it means nothing. And yet probably each one of us unconsciously forms a fleeting mental picture of some of these products whenever we see the two figures. In the newspaper and magazine advertising which has gone before, Heinz has interwoven many plots. We read of the immaculate condition of the factory itself; how the girls' hands are manicured each morning before going to work, and their clothing cared for with hospital exactness. Our confidence is gained by inviting us all to visit the factory where these wonderful pickles and condiments are produced. Again we are led to picture their deliciousness by description of the ingredients, written with a skill calculated to tempt the appetite, until we determine that our very next purchase in that line shall be one of the famous "57" varieties. So persistently have all these details been impressed upon our minds by the printed advertisements, and so persistently have they become associated in our minds with "57" that we unconsciously and invariably merge the two ideas, and it requires but the numerals to bring up the entire picture again—to furnish the plot; just as the word "dolls" does to the little girl, or the word "corns" to the sufferer.

Now we must bear in mind that in principle at least our ads should be written to sell dolls to men; corn-preventative remedies to men who have no corns; and pickles which have not already been made famous.

Perhaps you've noticed the sudden awakening among the book publishers. Everybody knows that a novel is going to contain a girl—The Girl—and a man, who finally proves to be The Man, together with some hand-picked difficulties; but all at once the wise men who market these diversions are really saying something in their ads. Pick up any magazine and you will find half a dozen book advertisements which, while more or less alike, really make personal contact with the reader. Usually there is a picture of a girl sitting on nothing in particular, and dangling her legs, which are decorated with silk as far as possible—and that is quite a way. Then we go on something like this—

"Unhand me Villain"

Said the beautiful shop girl. "I hear the sound of approaching footsteps on horseback." She was just an unspoiled country girl and he—he was a man of the world, wealthy and accustomed to having his way with such as she. He had found her poised on the river bank, a bottle of cyanide in one hand, a revolver in the other. Then there was the boy from home, but—

Now you know right away whether that book is going to appeal to you or not. If you like that sort of a story you will buy it, and if you don't you wouldn't have bought it anyway, from merely seeing its title, the number of pages, the quality of the paper and the price. It is a fine example of personal contact, or human interest as the newspaper boys would say—and every one of us may learn much by studying it, for it is an advertisement with a selling plot. If the moving picture people ever learn how to advertise they will soon have all the money in the world in their coffers.

AN INSTANCE OF THE REWARDS OF THE ELECTRIC PUMP

In a recent issue of the Pacific Service Magazine an interesting description of the Yolo District of the Pacific Gas & Electric Company is set forth. The notable feature is the strong aid that is being rendered to agricultural production by the electrical pump, which is typical of hundreds of other districts throughout the West.

In this instance about twenty thousand acres have been added to the available land in California by means of a battery of six 800 h.p. pumping units installed in Reclamation District No. 1500 pumphouse in the Sutter Basin. This district, comprising fifty-five thousand acres, is being reclaimed, but up to the present time the leaves have not been entirely completed. The flood water from the Sacramento and Feather rivers spreads over a greater part of the land in winter. In summer, when the rivers drop, a lake is left covering about twenty thousand acres. To drain this land the electric pumps are started and are run night and day until the entire area is drained. Each pump has a capacity of over seventy thousand gallons per minute, and the entire plant has a capacity of approximately 600,000,000 gallons per day, or enough water to supply the city of San Francisco for about fifteen days. It is said to be the largest reclamation pumping plant in the world.

This very fertile land produces a wonderful yield of various kinds of beans. During the latter part of June, after the pumps have finished draining the land, a small army of farmers with traction engines and farming implements of all kinds start to plow and plant the land to beans. The average yield will be close to fifteen sacks per acre and in this section alone the crop will be worth approximately $5,000,000.

SIZE OF SERVICE WIRES FOR A GROUP OF MOTORS

BY F. D. WEBER.

(The question of feeder sizes is an important question and one which has been treated little in the technical press and text books. This article treats this subject as applied to motor installations and evolves a method original and practical, whereby an immense amount of money can be saved by the owners when installing new motor equipment and at the same time satisfy the requirements of the most exacting inspection department. The principles involved are based upon sound engineering considerations. The author is electrical engineer for the Oregon Insurance Rating Bureau.—The Editor.)

The proper size of service wires for one squirrel cage induction motor and one direct current motor is definitely established by Rule 8 (c) and Rule 8 (d) of the National Electric Code, Edition 1915, but confusion arises as to what the proper size of mains should be when there are more than one motor connected to the same mains.

The following methods are based on the supposition, that the smaller motor, if only two are involved in the installation, or all except the largest one might be running at the full load, then the largest one of the group would be started. The probability of the starting of all the motors at the same time is quite remote and not very often encountered. When the number of motors increases a likelihood of the starting of all the motors at the same time becomes more remote, but if it is definitely known that more than one motor in a group will be started at the same time, then the starting current of all such motors must be considered. In the absence of a definite diversity factor, being known, we can proceed as follows: If two motors of relatively small horsepower are to be considered, we have several methods to determine the size of mains now used in various sections of the country.

Considering alternating current motors only:

For example, two motors being 220 volts, 3-phase, 60-cycle constant speed, squirrel cage type, induction motors, started by means of standard auto-starters and wired on a system in which starting and running fuses or equivalent protection is installed for each individual motor, motors being of 5 and 10 h.p. respectively.

Method 1. Under rule 8 (c) last paragraph a table is given for current carrying capacity of wires to be used with a.c. motors, based upon the full load current of the motors as follows:

Rated full load current.	Percentage
0-30 amperes.	250
31-100 amperes.	200
above 100 amperes.	150

Therefore, taking the full load current of the smallest motor, plus the starting current of the largest motor based upon this table, we get the total current necessary to start the largest motor when the smallest motor is running at full load. Then by Rule 8 (c) fifth paragraph, the following is stated:

"Where a rubber covered conductor carries the current of only one a.c. motor of the type requiring large starting current it may be protected by a fuse or an automatic circuit breaker without time limit device, rated in accordance with Table B of Rule 18 (which is the rating for other insulation than rubber.) Therefore, instead of taking the value obtained for the starting current for the largest motor take the Table B rating for this value and add to the full load current of the smallest motor. Then by referring to Rule 18 Table A obtain the size of rubber covered wire corresponding to this value of total current shown in the table.

Example 1. One 5 h.p., full load starting current, 13.3 amp.
One 10 h.p., full load starting current, 25.5 amp.

According to Rule 8 (c) the starting current of a 10 h.p. motor equals 25.5 times 250 per cent equals 63.75 amps.

Then by Rule 8 (c) paragraph 5, by referring to rule Table 18 (b) we get No. 6 B. & S. gage rubber covered wire with a capacity of 50 amps., when rated according to table under rule 18 (a), therefore, 13.3 plus 50 equals 63.3 amps., or No. 4 B. & S. gage rubber covered wire for feeders (mains) to serve the 5 and 10 h.p. motors and the same can be fused as high as 70 amps., by table under Rule 18 (a).

Method 2. Proceed as in Method 1, only add the starting current of the largest motor directly to the full load current of the smallest motor and proceed to find the sizes as by Method 1.

Example 1. Same conditions and example. Starting current by application of Rule 8 (c) equals 63.75 amps. Then by table under Rule 18 (a) size should be No. 4 or 70 amps., capacity to be added instead of 50 amps., as by Method 1, then we have 13.3 plus 70 equals 83.3 amps., or No. 3 B. & S. gage rubber covered wire for service wire to feed the 5 and 10 h.p. motors and same can be fused as high as 80 amps. by table under Rule 18 (a). These methods are based upon the fact that the National Electrical Code does not state that feeders or mains can be overfused according to Table 18 (b) when used with a group of induction motors.

Method 3. Take the total full load current of both motors plus 50 per cent and furnish proper size wire according to Rule 18 (a).

Example 1. Same conditions and example. The total full load current is equal to 38.8 amps., plus 50 per cent for overload on all motors equal 58.2 amps. Then by table under Rule 18 (a) we have No. 4 B. & S. gage rubber covered wire and same can be fused as high as 70 amps.

Method 4. Take the full load current of smallest motor plus 150 per cent of the full load current of the largest motor and furnish proper size of wire according to Rule 18 (a).

Example 1. Same conditions and example. 13.3 amps. plus 150 per cent of 25.5 equals 51.55 amps. This amount being added to take care of the starting of the largest motor and we now get No. 6 B. & S. gage rubber covered wire by referring to tabe under Rule 18 (a) and can be fused as high as 50 amps.

Method 5. Same conditions and problems. (City of Chicago's practice). When only one motor is connected to mains the following sizes are required:

Example 1—1-5 h.p. No. 12 B. & S. gage rubber covered wire.
1-10 h.p. No. 6 B. & S. gage rubber covered wire.

When the two motors are connected on the same mains No. 6 rubber covered B. & S. gage wire may be used and can be fused to 50 amps. This is arrived at in the following manner: Motor efficiency assumed at 90 per cent, power factor 85 per cent, and the overload is considered at 50 per cent (established by special rule in the Chicago City Ordinance), therefore

$$\frac{746}{220 \times 1.73 \times .90 \times .85} = 2.56 \text{ amps. per h.p.}$$

Applying these tables, in the case of mains, no overload capacity is considered unless one motor forms a large proportion of the total load in which case main must be at

[1]No voltage drop taken into consideration.

least as large as that given under the table for a large motor alone. Unless the overload capacity on the largest motor demands the use of a wire larger than that shown under the head of "Mains" no attention is paid to the overload on these mains. The table is made up as follows: (Only six motors being shown in this table):

Size of Wires for 3-phase Motors—220 Volts, 60 Cycle

h.p.	Full Load Current	Size of Wire 1 Motor	Size of Wire Mains
5	13	12	14
10	26	6	8
15	38	4	6
50	128	0000	0
75	192	350,000	0000
175	448	1,100,000	600,000

Instead of, the small motors, suppose we substitute

Example 2.—2-50 h.p. motors.
1.75 h.p. motors.

which are installed in the same group under the same conditions, then we have:

Example 2. Method 1. Full load current of 2-50 h.p. motors = 246 amps.; of the 1-75 h.p. motors = 186 amps., then according to Rule 8 (c) the starting current of 1-75 h.p. motor = 186 times 150 per cent equals 279 amps., then by the fifth paragraph of Rule 8 (c), under rule 18 (b) we have 000 B. & S. gage rubber covered wire or 175 amps. Therefore, 246 amps., plus 175 equals 421 amps., equals 550,000 cir. mil. B. & S. gage rubber covered cable for mains to feed the 2-50 h.p. and 1-75 h.p. motors. These mains can be fused as high as 425 amps., by rule under table 18 (a).

Example 2. Method 2. 246 amps., plus 279 equals 525 amps., or 750,000 cir. mils to feed these motors and the same can be fused as high as 525 amps., by table under rule 18 (a).

Example 2. Method 3. 246 amps., plus 186 amps., equals 432 amps., times 150 per cent, equals 648 amps., or 1,000,000 cir. mils rubber covered cable will be necessary for these mains which can be fused at 650 amps.

Example 2. Method 4. 246 amps., plus 150 per cent of 186 equals 523 amps., for which 750,000 cir. mils. must be furnished which may be fused to 525 amps.

Example 2. Method 5. Referring to table above, we have mains equals 600,000 cir. mil. B. & S. gage rubber covered cable.

When tabulating the results of the above examples we have for the first example under the various methods:

Example 1.

Method 1—No. 4 B. & S. gage R. C. wire for mains, 70 A. fuses.
Method 2—No. 3 B. & S. gage R. C. wire for mains, 80 A. fuses.
Method 3—No. 4 B. & S. gage R. C., wire for mains, 70 A. fuses
Method 4—No. 6 B. & S. gage R. C. wire for mains, 50 A. fuses.
Method 5—No. 6 B. & S. gage R. C. wire for mains, 50 A. fuses

For the second example under the various methods:

Example 2.

Method 1— 550,000 cir. mil. R. C. wire for mains, 425 A. fuses.
Method 2— 750,000 cir. mil. R.C. wire for mains, 525 A. fuses.
Method 3—1,000,000 cir. mil. R. C. wire for mains, 650 A. fuses.
Method 4— 750,000 cir. mil. R. C. wire for mains, 525 A. fuses.
Method 5— 600,000 cir. mil. R. C. wire for mains, 450 A. fuses.

It is very apparent that the method of finding the sizes of mains do not produce uniform results and consequently, let us analyze each method.

Method 1. Examples 1 and 2.

The results are consistent when applied to the first problem but when considering the second by this method we have the mains at 550,000 cir. mil. cable, but the total full load current of the three motors equals 432 amps., which is larger than the rated capacity of 550,000 cir. mil. cables. Consequently, on small motors Method 1 gives satisfactory results but on larger motors, the results may be too small.

Method 2. Examples 1 and 2.

Is a consistent method for both small and large motors and allows practically 25 per cent overload to be carried on all motors.

Method 3. Examples 1 and 2.

For a group of small motors does not provide for, the starting current for the largest motor. For the group of larger motors it will not provide a capacity for the 25 per cent overload condition which is sometimes necessary on each of the motors.

Method 5. Examples 1 and 2.

Same as method 4 for small motors. On larger motors not provided for overload.

Considering direct current motors only:

Method 1. Under Rule 8 B fifth paragraph, the following: "Conductors carrying the current of only one motor must be designed to carry a current at least 25 per cent greater than that for which the motor is rated. Where the conductor under this rule would be over fused in order to provide for the starting current, as is the case of many alternating current motors, the conductors must be of such size as to be properly protected by the fuses." Take the full load current of the smallest motor plus 125 per cent of the full load current of the largest motor and furnish the proper size of wire by Rule 18 (a).

Apply to first example, with the changes that motors are 230 volt direct current.

Example 1. 1 5 h.p. full load current — 19 amps.
1-10 h.p. full load current — 37.6 amps.

Then 19 plus 37.6 times 125 per cent equals 66 amps., mains equal No. 4 B. & S. gage rubber covered wire by Rule 8 (B) and 18 (a).

Method 2. Take the total full load current of both motors and add 25 per cent to this value and furnish the proper size of wire according to Rule 18 (a).

Example 1. 19 plus 37.6 equals 56.6 amps., times 125 per cent equals 70.75 amps. Therefore, mains equal No. 4 B. & S. gage rubber covered copper wire by Rule 18 (a).

Method 3. City of Chicago Method.

Assumed efficiency 90 per cent, full load current of motor is calculated on the basis given by the following:

$$\frac{746}{220 \times .90} = 3.75 \text{ amps., per h.p.}$$

the 25 per cent is added for overload for Rule 8 (b).

The following table being constructed on this basis.

Size of Wires for d.c. Motors, 220 Volts

h.p.	Full Load Current	Size of Wire 1 Motor	Size of Wire Mains
5	19	10	12
10	38	6	6
15	56	4	5
50	188	250,000	0000
175	281	500,000	300,000
175	656	1,300,000	900,000

The column headed "Sizes of Wire Mains" gives size of wire to be used for mains but in no case must the size of these mains be less than that required for 25 per cent overload, on the largest motor such mains supply.

Now applying this to example under Method 1, size of mains equals No. 5 B. & S. gage rubber covered wire.

Method 1. Instead of small motors suppose we substitute

Example 2. 2-50 h.p. approx. full load current 376 amps.
1-75 h.p. approx. full load current 281 amps.

Proper size of mains then equals 1,200,000 cir. mil. cables.

Method 2. Example 2. 376 amps., plus 281 amps., equals 657 amps., times 125 per cent, equals 821.25 amps. Mains must be equal to 1,400,000 cir. mil. cables, by Rule 18 (a).

Method 3. Example 2. We have size of mains equals 900,000 cir. mil. cables.

Then tabulating the results of the above examples, we have for the first example under the various methods.

(Concluded on Page 172)

RESERVOIR CAPACITY FOR SMALL PUMPING PLANTS

BY S. T. HARDING

(The proper capacity of reservoirs for various rates of discharge and the discharge of reservoir outlets for various sizes and losses of head are problems in economic design in electric pumping plants that, when properly solved, aid much in still further extending the economic use of electric energy in this lucrative field of central station load. Here are excellent data on this subject, compiled by the author who is an irrigation investigator at the University of California, which should prove helpful to central station activities throughout the irrigable districts of the West.—The Editor.)

A Corner of a Small Reservoir

THE advantages which may be secured through the use of reservoirs in connection with pumping plants have been appreciated by those connected with such irrigation practice. The actual use of such reservoirs to any general extent in any locality has usually not taken place until electric power for such pumping has been made available. The advantages to the power company which result from the higher load factor and smaller peak loads are obvious. The advantages to the consumer are also obvious where the operation season is long, particularly where the lift is sufficiently great to make the total cost of pumping relatively high. The advantages to the consumer using irrigation only as a supplementary supply with short operation seasons or for low lifts are not as great. The competition with gasoline engine plants for such conditions has caused some power companies to offer irrigation rates designed to meet such competition rather than to produce a character of use which results in the most desirable load characteristics. Where the irrigation use represents only a relatively small part of the connected load, such rates may be feasible although not returning a direct profit; where the business of a power company is largely pumping for irrigation it is necessary that the rates be made so as to control the character of use of power. Rates on this latter basis are also equally desirable for all cases where competition with other forms of power will permit.

Advantages of Large Irrigation Heads.—It is generally recognized that to secure the best results in the irrigation of any crop, at least a certain minimum size of irrigating head or stream is required. This is necessary both for efficiency in the use of the water and in the labor of its application. It is particularly true for methods of irrigation in which the land is flooded. The stream used should be large enough to occupy the time of one irrigator if labor costs are to be kept at a minimum. In flooding land, the use of small irrigating heads results in the absorption of excess amounts of water at the upper end of the runs due to the longer time required to cover the checks or runs used. By using larger heads, the water can be crowded over the land with both a more uniform distribution and a less total quantity used. With furrow irrigation the difference in the efficiency in the use of smaller heads is not as marked as the number of furrows used at a time can be adjusted to the stream available. The labor efficiency will be reduced, however, unless the head used will supply as many furrows as can be attended to by one man.

The effect of the size of the irrigation head on the depth of water used per irrigation is illustrated by results given in the recently issued Bulletin No. 3 of the California Department of Engineering. On the silt loam soil of the University Farm at Davis measurements were made of the amount of water required to cover a one-acre check having a slope of 3½ inches per 100 ft. when applied at different rates. The data obtained were as follows:

Rate of Application and Depth of Water

Rate of Application Cubic Feet per Second per Acre	Depth of Water Required, feet
4.6	2.75
10.1	1.86
13.5	1.16
15.3	.84
17.8	.69

The greater efficiency obtained with the larger heads is very noticeable. These results are reduced to the equivalent size of head for a check containing one acre. With pumping plants even with reservoirs the heads secured do not often exceed 6 second feet. The area of checks should be proportionately reduced. For such conditions of soil and slopes, checks of about ¼ acre should be used for heads of 5 second feet. For smaller heads smaller checks are required for efficient use of the water.

The effect of the soil on the size of irrigation head is also brought out in the same bulletin. The results of a large number of observations in the Sacramento Valley indicated that the average size of irrigation head in second feet per acre used in checks is 23 for gravelly loams, 10.9 for sandy loams, 8.8 for silt

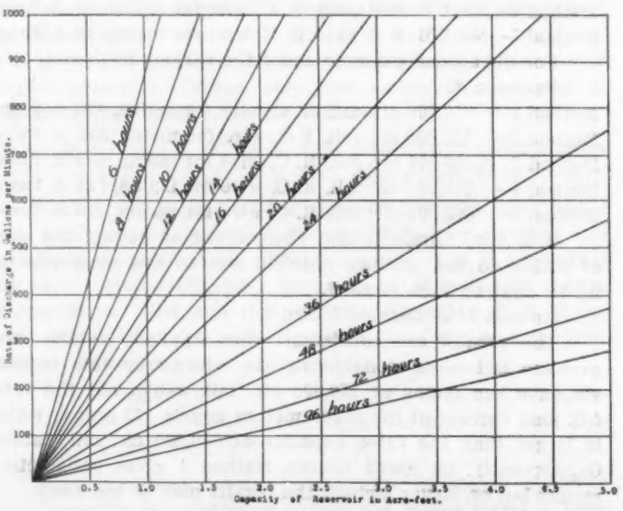


Fig. 1. Capacity of Reservoirs Required to Hold Various Rates of Discharge for Different Periods

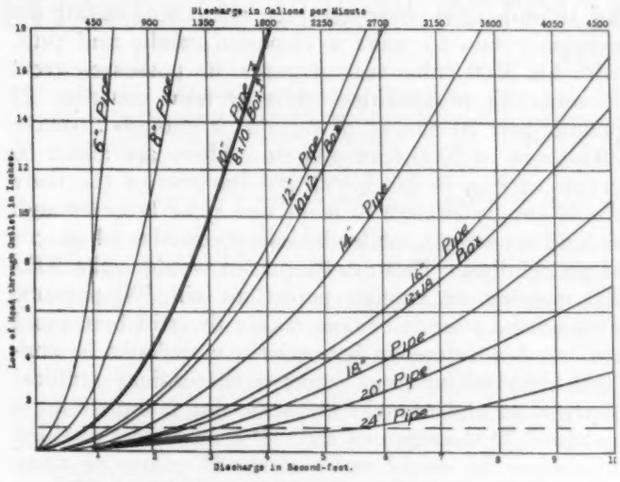


Fig. 2. Discharge of Reservoir Outlets for Various Sizes and Losses of Head

loams, 7.3 for clay loams and 3.2 for clays. The checks used on the coarser soils are usually about ¼ of an acre. The relation of size of head and area of check is particularly important on porous soils having high rates of absorption. With heavy soils the problem more frequently consists of getting sufficient moisture into the soil rather than in preventing deep percolation.

The desirable head for any condition of irrigation under individual pumping plants can be secured by either installing a plant having sufficient capacity to deliver the required flow directly or by smaller plants used in connection with reservoirs. With such reservoirs wells of small yield can be used for efficient flooding of porous soils, relatively large irrigation heads for short periods of use being secured.

Required Capacity of Reservoirs.—In selecting the capacity of a reservoir several factors require consideration. The smallest reservoir used with pumping plants should hold the discharge from 14 hours pumping. Such a reservoir will hold the quantity pumped during the night. In some cases the reservoir may hold the quantity pumped from Saturday night to Monday morning. With wells of very small yield, a sufficient capacity to hold several days pumping may be used. Smaller capacities than one-fourth acre foot are not usual. Such a reservoir will hold enough water to irrigate one-half acre 6 inches deep. Fig. 1 shows the capacities required to hold different rates of discharge for different periods of time. It is usual to provide a reservoir capacity to hold 24 hours pumping.

After the capacity has been selected it is necessary to choose the area and depths. Fig. 1 gives capacities in terms of acre feet. An acre foot is equal to 43560 cubic feet, or 325,851 gallons. For any capacity there is a relation between the area and depth which will give the minimum amount of material in the banks where the reservoir is built from material excavated from the inside. Such a relation is very involved, however, and if the value of the land used is neglected gives reservoirs of large area and shallow depth. These are objectionable due to the greater seepage area. The smaller pressures on the outlet gates make the use of larger outlets necessary. For these reasons it is usual to select the depth of water desired and then compute the area required to give the capacity needed. For small reservoirs a depth of water of 4 ft. is usual; 5 or even 6 ft. may be used where the size exceeds 150 ft.

Reservoirs must be located so as to be above the land to be served. It is economical to use material excavated from the inside of the reservoir to make the banks. Unless located on higher land this may make the elevation of the inside too low to enable water to reach the fields. Unless such higher land is available it will be necessary to build the reservoir entirely above the ground surface, securing the material required from adjacent areas. Such construction is more expensive than that for reservoirs partly in cut.

Outlets for Reservoirs.—Outlets for small reservoirs usually consist of a pipe or box through the bank controlled by a gate on the inside. For sloping banks this requires some form of bridge from which to operate the gate. This is preferable however, to placing the gate on the outside as the outlet has to withstand reservoir pressure in this case.

The size of outlet is determined by the discharge from the reservoir when nearly empty. If the bottom of the reservoir is only slightly above the land served a large outlet will be required in order to maintain the rate of discharge when the water in the reservoir is low. A difference of elevation between the water surface in the reservoir and in the outlet ditch of 6 in. is usual. Unless this loss of head is available through the outlet the size will have to be increased in order to secure sufficient discharge. Such outlets operate as submerged orifices with short tubes, the discharge depending on the area of the opening, the square root of the loss of head or the difference in elevation of the water surface on the inside and outside and some coefficient whose value depends on the form of the opening. This coefficient may be as low as 0.70 for steel slide gates or as high as 0.80 for wooden outlets. It varies with similar types of gates depending on the velocity of approach, shape of opening and other factors. Fig. 2 shows the discharge to be expected under different conditions sufficiently closely to serve as a basis for the selection of the size to be used.

The top of the outlet pipe should be placed at the elevation of the bottom of the reservoir, so that a good rate of discharge can be secured when the reservoir is nearly empty. The bottom near the outlet can be graded so that flow to the outlet will take place. The length of the outlet depends on the height and slope of the embankment. For usual banks the length of outlet is equal to the top width plus about 4 times the height of the bank. The cost of outlets depends on the size and length of pipe. Including a bridge and the necessary excavation and backfill the average cost for concrete pipe outlets with good grade of iron gates may be taken as $8 for 6 in. pipes in small reservoirs, $10 for 8 in., $15 for 10 in., $20 for 12 in., $25 for 14 in. and $30 for 16 in.

Wooden box outlets are sometimes used. These are somewhat cheaper than pipe outlets of equal capacity but are less permanent and it is more difficult to prevent leakage at the gate. The smaller sizes used

are those formed by 4 pieces of the commercial sizes of lumber giving boxes such as 8 x 10 or 10 x 12. For larger sizes 12x18 is usual. For small sizes 1 in material is generally used, for the larger sizes 2 in. thickness is required. The discharge is similar to that of pipes of equivalent area. The gates are wooden slides, the guides extending to the bridge from which it is operated, the costs in place are about $9 for 8 x 10, $12 for 10 x 12 and $20 for 12 x 18 for the usual lengths of box required.

The discharge from the pump is more generally conveyed over the top of a reservoir than into the bottom. When the inflow is at the bottom the average height to which the water is pumped is less with some saving in power which may affect the consumers cost where meter rates are used. For high lifts the saving for the usual depths of reservoirs is relatively small. An inlet in the bottom of the reservoir requires a valve in the discharge line of the pump to prevent the water flowing back through the pump when it is not operating. A check valve is frequently used to relieve the pump casing of the static pressure when the pump stops but such a valve may not close tightly, causing leakage. To avoid any chance of backflow the majority of plant owners carry their inlet pipes into the reservoir just above high water level.

A RIVAL TO X-RAYS

According to the Electrical Review of London the Patents Court has recently disclosed that the Rontgen-rays are no longer the only agency which will enable organic bodies to be examined internally. A remarkable process was discussed when the Trustees of the South Kensington Museum (Natural History Section) applied for license to use a German patent which imparts to animals a transparency so thorough that every bone, muscle, and artery can be seen distinct through the skin.

Dr. S. F. Harmer, F. R. S., who made the application, said the transparency was not something vague, like a radiograph, with blurred outlines; it was a transparency vivid and direct as that of glass itself. The supreme advantage of the method was that every specimen treated became a permanent object lesson for study purposes or museum exhibition. He had a rat whose every organ could be seen. The process employed the principle of the refraction of light, and it relied upon chemical solutions, made according to formulae, to have each a required index of refraction.

The Controller of Patents (Mr. Temple Franks) said he thought nothing should be allowed to stand in the way of the authorities at the British Museum making full use of this process, though he did not see how anyone could very well claim a patent right in the principle of the refraction of light.

CHEMISTRY OF MAN

According to a writer in Monad, as digested by the Electrical Age, a man weighing 150 pounds approximately contains 3500 cubic feet of gas, oxygen, hydrogen and nitrogen in his constitution, which at 80 cents per thousand cubic feet would be worth $2.80 for illuminating purposes. He also contains all the necessary fats to make a 15-pound candle and thus, with his 3500 cubic feet of gases, he possesses great illuminating possibilities. His system contains 22 pounds and 10 ounces of carbon or enough to make 780 dozen or 9360 lead pencils. There are about 50 grains of iron in his blood and the rest of the body would supply enough to make one spike large enough to hold his weight. A healthy man contains 54 ounces of phosphorus. This deadly poison would make 800,000 matches or enough poison to kill 500 persons. This with 2 pounds of lime makes the stiff bones and brains. No difference how sour a man looks he contains about 60 lumps of sugar of the ordinary cubical dimensions, and to make the seasoning complete must be added 20 spoonfuls of salt. If a man were distilled into water he would make about 38 quarts or more than half his entire weight. He also contains a great deal of starch, chloride of potash, magnesium, sulphur, and hydrochloric acid in his system.

Break the shells of 1000 eggs into a huge pan or basin and you have the contents to make a man from his toenails to the most delicate tissues of his brain. And this is the scientific answer to the question, "What is man?"

(Continued from Page 169)

Example 1.

Method 1—No. 4 B. & S. gage R. C. wire for mains, 70 A. fuses.
Method 2—No. 4 B. & S. gage R. C. wire for mains, 70 A. fuses.
Method 3—No. 5 B. & S. gage R. C. wire for mains, 55 A. fuses.

A second example under the various methods:

Example 2.

Method 1—1,200,000 cir. mil. R. C. wire for mains, 730 A. fuses.
Method 2—1,400,000 cir. mil. R. C. wire for mains, 810 A. fuses.
Method 3— 900,000 cir. mil. R. C. wire for mains 600 A. fuses.

It is again apparent that the methods of finding the size of mains for direct current motors do not produce uniform results and when analyzing these results we are forced to conclude as follows: analyzing—

Method 1. Examples 1 and 2.

Consistent results are obtained from both small and large motors and these results are generally acceptable on small groups.

Method 2. Examples 1 and 2.

Quite frequently mains computed under this method cause too extravagant use of copper and are necessarily large.

Method 3. Examples 1 and 2.

Quite frequently mains are too small and have to be increased in size.

As yet we have only considered small groups of motors less than five in number and it is apparent that confusion exists due to the various methods used commonly in computing the size of the mains.

When there is a greater number of motors in a group than considered here, the "Demand Factor" enters into consideration also and becomes generally a predominating factor in determining the proper sizes of mains.

Consequently, the Electrical Board of Appeals, Portland, Oregon, realizing the confusion, have devised a method of attack which is original and unique.

This treatment of Demand Factor will be set forth in a later article which will appear in the columns of the Journal of Electricity.

PHASES OF THE ELECTRICAL CONTRACTORS' BUSINESS

BY H. C. REID

(Even the electrical contractor who deals largely in material fixtures, finds himself face to face with questions of public policy. Here is a masterly article that treats of interesting and important phases of the contractor's business in his relation to the public, in addition to covering items that affect his system of cost accounts. The author is the newly-elected president of the California Association of Electrical Contractors & Dealers. This paper was read at the recent Santa Cruz Convention of the Association and should prove helpful to other contractors throughout the West.—The Editor.)

In considering the electrical contractors' and dealers' business as a whole, we find many conditions that are productive of discussion. Constructive criticism is one of the best means at our command to show up the defective elements of our business.

The electrical contracting business has been lacking in those financial returns that would be deemed proper and adequate for an industry of this volume and character. The part that the contractor has in contributing to the health and comfort of mankind, the energy and ingenuity he expends in the performance of his work, the capital he invests, which is subject to greater risks than the majority of commercial or manufacturing enterprises, most certainly justify the expectations of a fair and reasonable profit as his returns.

A MOTTO FOR THE ELECTRICAL CONTRACTOR

"Whatever promotes the welfare of that broad group of people which we call the public, is bound to react favorably on individual concerns."

In reviewing the situation we find as the first and foremost of the causes tending to create an unhealthy business condition, the lack of an adequate knowledge of costs. We find that undue and unjustifiable credit privileges on the part of jobbers and other sales mediums contributes its part. We find also many poor and incomplete plans and specifications that cause a financial loss to the contractor. We find an abscence of state or municipal licensing or examining commissions which should pass upon the qualifications of those conducting business. We unfortunately find that the majority of electrical contractors and dealers lack the proper commercial training in business management and financing.

Each one of the features above quoted is responsible for a certain portion of the defects of the business, but of all those quoted, unquestionably the first one,—that is, the lack of knowledge of costs,—is the most vital. This requirement is so broad in its full scope and so far reaching in all phases of the business that we might be able to disregard, temporarily at least, the others mentioned, if we were all thoroughly well schooled in the subject of costs.

Costs are the beginning of all our transactions, and on the properly determined cost depends the profit or loss as the final result. It is of vital importance to the contractor that he be thoroughly familiar with the different elements entering into the cost of doing business. Not until he is familiar with these costs will he be able to so conduct his business that an actual net profit will be the result,—but cut-throat competition, as a result of insufficient knowledge of costs, has been so long an established practice, that we have as a further obstacle prevalent acceptance of costs that are not complete costs, and percentages added for profit, that are entirely inadequate.

As much of our work is done under the supervision of architects and consulting engineers, our interests demand that they should be made familiar with the facts about our business requirements. While they generally accept the fact as correct that a contractor has some overhead expense, I do not believe they understand or appreciate the reasons for different percentages existing in the different trades, and doubtless also it is difficult for them to accept without question the statement and assurances in regard ent percentages existing in the different trades, and doubtless also it is difficult for them to accept without question the statements and assurances in regard to costs of some contractors who are endeavoring to obtain an actual net profit for their work, in comparison with the actions or figures of other contractors who to all appearances are as well qualified to know their business needs.

We are advised by the Federal Trade Commission that only 10 per cent of the American manufacturers and merchants actually know their costs of doing business. It is the aim and endeavor of this association to so gather and distribute the facts, that the electrical contractors and dealers of the Pacific Coast will be added to the 10 per cent. As a result of several hundred thousand businesses investigated by the commission, they give us these pertinent facts:

200,000 corporations out of 260,000 are merely ekeing out an existence; 100,000 of these corporations are not earning any net profits.

30,000 out of 60,000 doing a business of $100,000 a year each, have such a vague idea of management that they charge off no depreciation.

The figures quoted are authentic; they show that 90 per cent of all the business concerns are drifting blindly along without profit to themselves, a menace and a danger to established and legitimate business.

Let us learn from the Federal Trades Commission these lessons in the first principles for the conduct of business.

Let us hope that as a result of this convention an interest has been stimulated to an intelligent study of business problems, its defects, its needs and its remedies. Let us endeavor to secure in the efforts for betterment, the co-operation of not only those different branches of the electrical industry, but of other business interests. Let us hope that all, the contractor, the architect and engineer, the public, will better appreciate the fact that ignorant and cut-throat

competition is dangerous to the community as well as the individual.

The methods followed to obtain all of the costs upon which to make a bid, or to determine the selling price of your material or labor, differ widely. An estimate form upon which can be listed accurately and clearly the many articles and the many different segregations of labor entering into a job, is, first of all, a necessity. Many different forms are in use, being the individual's ideal of what an estimate should show and record. Our California State Association has furnished its members with an estimate form which is the result of the study of the forms previously used by several companies, and from that study, a standard estimate form has been prepared, combining the several good features found.

The ideal estimate should present complete information to any one, not only the estimator, of all features of the job. The estimate should be divided into the same natural divisions as the job. To state that more fully: Each floor of the building should have its material separately listed. Each different part of the electrical systems, such as lighting, power, telephone, both public and private, bell systems, clock systems, calling systems, fire alarm systems, etc.,—all should be so recorded that the cost of any one system can be readily separated from the total, as is frequently needed on account of alterations or omissions. An estimate is just an opinion of the estimator as to the amount of material and labor entering into the work in question, and the correctness of these items can only be proven by a proper and accurate system of cost accounting.

Some contractors have no accounting system at all—some know their costs only when the job has been completed, and in most cases the changes and alterations in the original job so confuse their records that a direct comparison of the cost records and the estimated costs does not give a satisfactory answer as to accuracy of the estimate.

We should have for the proper conduct of our business, first, a detailed estimate; second, detailed weekly reports that can be checked against the estimate. This system of reports must not be burdensome with too much detail, as it must be, by necessity, prepared and submitted by the workmen on the job, and must, for the sake of economy and time at the office, be simple and concise. This cost data should be tabulated and submitted to the estimator with regularity.

Manufacturers devote a great deal of attention to the compiling of cost data, and as a result, they are generally enabled to fix their selling prices so as to maintain a sound financial condition.

Incidentally, it would seem reasonable to believe that our State University should be able to assist us in the preparation of the cost accounting system needed by our particular industry.

The cost of an electrical installation is divided into three general divisions: material, labor, overhead expense. By means of the estimate previously described, we determine the cost of the material and the labor, and by means of the accounting system maintained, we determine the cost of doing business. into that last item is charged those expenses that are not a direct result of any particular job. The item of overhead expense absorbs a multitude of expenditures. Not only does it include the salaries of the executives, superintendents, estimators, clerks, shop expense, office expense, taxes, fire insurance, advertising, dues of commercial clubs, associations, etc., but it must also include the elusive items of depreciation of tools, merchandise, office fixtures, automobiles, the obsolescence of materials as well as interest paid on borrowed capital. It must absorb the loss on bad accounts, losses on jobs—which are inevitably bound to occur,—and in fact, all that long list of items that are included in the conduct of a business.

I wish to note here that some concerns take into overhead, the items of cartage to jobs, compensation and liability insurance. Cartage should be charged direct to the job, and insurance costs should be pro rated to the different jobs, using the amount of labor paid as the basis for pro rating. As the total annual overhead expense must be distributed over the business done, this cost must be added to the estimated cost of the labor, material and incidental items above mentioned, as a percentage in an amount that the annual overhead bears to the sum total of costs of all jobs done in the same period.

As an illustration of the foregoing, let us assume that your average overhead expense for the year is $10,000, and also assume that the labor and material cost of jobs is $40,000. Therefore, the overhead expense for that period is 25 per cent of the job costs, and so the sum of 25 per cent must be added to your labor and materials estimate, to determine your actual total cost.

If, to your cost now determined, you add the sum of 20 per cent for profit, we now can compute your net profit for the transaction as 16 2/3 per cent on the sales price.

As a further illustration of this summary:

The cost of labor and material is, say.....	$1000.00
Overhead expense, say, 25 per cent.....	250.00
Total cost	$1250.00
Profit, say 20 per cent.....	250.00
Selling price	$1500.00

The $250 added for gross profit, therefore, equals 16 2/3 per cent net.

The percentages to be used must logically be determined by each individual as the requirements of his business dictates, and as may be expected, a wide range of costs exists. During the past fiscal year of the Association, an effort has been made to secure from its members, statements giving their costs of doing business for the year, and their gross volume of business done.

As there is no standardized system used, however, to compute overhead expense, an analysis of accounts would disclose the fact that what some concerns consider overhead, another has overlooked or not considered.

Profits: Around this subject of profits revolve all our business activities. Success or failure hang on this work. The profits that accrue to you will not be

due, however, entirely to your individual efforts. The success and prosperity of your competitor is as necessary before you can count your profits as is your success necessary for him.

I believe I am violating no confidence in telling you that the electrical contracting business has been short on profits, which is due largely to the fact that the prices charged for our services have not been sufficient to yield a net profit. The discussion of this subject of profits leads us back immediately and directly to the subject of costs again. The percentage provided, for in estimates to yield profits has been absorbed to take care of the costs not estimated. How often does a contractor consider the length of time that his money will be tied up in a job, in determining the cost of that job? Invariably a discussion with the architect or engineer on the subject of profit brings out the fact that they expect you to perform work at a percentage fixed that has no consideration at all for the length of time of the investment. Many jobs are in course of construction for two years or even more; some jobs can be completed in two months. If a contractor could confine himself to the jobs being completed in two months, he would be able to turn his money over six times a year. If he confines himself to jobs running two years, the item of cost for capital invested would be twelve times the amount used for the same item in the first case mentioned.

A further illustration of this principle might be given you with this case as an example:

Assume that a contract that you have amounts to $20,000, with 25 per cent withheld until 35 days after acceptance, and that about time of completion, an alteration amounting in cost of labor and material to $500, is desired. Interest on $5000 (25 per cent of contract) held for one month due to additional work, at, say, 6 per cent per annum, equals $30. This cost is entirely due to the performance of the $500 job added, and it would seem that this latter job should bear the expense of this interest on the deferred payment as a part of its cost. Such, however, is not the custom, to the best of my knowledge.

It is to be seen that conditions of the kind cited are either forced on or accepted by the contractors as a result of their lack of knowledge of business and financial requirements.

Just what percentage of profit should be considered fair and reasonable is a matter for discussion.

In considering this we must bear in mind the several different characteristics of the business:

It requires technical knowledge and practical experience on the part of its manager.

It involves considerable financial risk due to conditions beyond the control of the contractor. Labor costs frequently vary as much as 50 per cent on account of construction methods followed by the general contractor.

On account of the irregularity in closing contracts for new construction work, the organization is not always working at its best efficiency.

Ten per cent seems to be generally accepted as a standard,—as being the proper amount for a contractor's profit, as evidenced by government contracts for ship-building, etc., building contracts for general construction and by the acceptance occasionally by electrical contractors of their portion of the work.

My contention is, that while 10 per cent may be entirely satisfactory on a ten or twenty million dollar job such as the Union Iron Works secured, 10 per cent shrinks perceptibly in its comparative sufficiency on a $100,000 job, and going one more step, 10 per cent on a $1000 electrical job almost entirely disappears from view. It should be noted here that the 10 per cent allowed on the immense government jobs is net, not gross, and that all the elements entering into the cost of doing business will be properly computed and included in the cost.

The electrical contractor knows too little about banking requirements and banking methods. In the past he has expected and has generally obtained the credit necessary from the jobber with whom he does his business, which has in turn contributed its measure as a demoralizing influence. It is obvious that when a creditor is placed in the position of carrying his customer for more than the customary credit period, he becomes indirectly a competitor of his other customers, which is unfair, both to his other customer and to himself.

It is thought by many that by the general use of the trade acceptances between the jobber and the contractor, better conditions will exist, first, for the seller on account of having a fixed date of settlement specified in the transaction, and second, for the contractor for the reason that it will be the means of compelling him sooner or later, to conduct his financial business with a bank and not a jobber. It will keep the buyer closer to his financial obligations, which in turn, require better collection methods and closer scrutiny to the credit he in turn extends, all of which tends toward better business.

One of the great and crying needs among business men today, to quote Edward N. Hurley, is a broad view of business in general, and a comprehensive grasp of the needs of industry as a whole. Too many American business men center all their energy and attention upon their particular establishment and the work of making profits for it.

Men at the head of factories need the point of view of what might be termed—the statesmanship of business. They need to appreciate the fact that their plant is a part of a great industry, that their individual welfare depends very largely upon the welfare and progress of their industry as a whole, and of industry in general.

Whatever promotes the welfare of that broad group of people which we call the public, is bound to react favorably on individual concerns.

At a recent meeting of the Physical Society of London, a demonstration of a method of preventing sparking at a rapid make and break, which incidentally produces colloidal platinum, was given by Dr. A. Griffiths. The device consists of a series of electrolytic cells placed as a shunt across the spark-gap. The electrodes consist of platinum and the electrolyte of strong sulphuric acid. The cells polarize, and on making the gap an e.m.f. is introduced opposed to the e.m.f of the battery, so that the current rapidly diminishes, decomposing the liquid and doing chemical work.

SUGGESTIONS FOR CONTRACTOR AND DEALER

DEPARTMENT CONDUCTED BY GEORGE A SCHNEIDER

(Private telephone installations, as distinct from the trunk line systems, are growing in importance as each month passes. The army cantonments, the office in the city, the home, the hotel, the apartment, the farm and its out-houses—all are finding ever increasing uses for the interior telephone system. Here is the very latest notation on pointers that should prove unusually helpful in running down and remedying the troubles that are encountered in this system of communication. The author is power apparatus specialist for a well-known electrical supply house of the West.—The Editor.)

HELPFUL NOTES ON INTERIOR TELEPHONE SYSTEMS

Apparatus for private intercommunicating telephone systems is now well standardized and there are numerous complete systems to meet the different requirements of the home and business. These systems differ only in the number of instruments that can be connected and the service performed. When using such apparatus, each party becomes his own operator and the number of instruments that can be connected to a given system is necessarily limited.

A complete system consists of the following:

(a) Telephone instruments.

(b) Necessary wires or cable to connect between instruments, batteries and other apparatus.

(c) Batteries to furnish current for talking or ringing.

(d) Miscellaneous accessory apparatus, when required, such as door openers, annunciators, letter boxes.

According to the class of service, the various systems may be grouped as follows:

(a) Code ringing, common talking.

(b) Selective ringing, common talking.

(c) Selective ringing, selective talking.

When properly selected and installed any system will give good service within the limits of its design, but the best and most satisfactory one is the selective ringing, selective talking system. It should be used where a high grade of intercommunication is desired. It permits of any station calling any other, and is absolutely non-interfering. That is to say, as many conversations can be carried on simultaneously as there are pairs of stations, without any conversation interfering with another. However, when any system is carelessly installed trouble is sure to develop and the telephone system is likely to become a nuisance and source of expense rather than a convenience and labor saving proposition.

It is the purpose in this article to discuss briefly a few of the most common troubles that develop in connection with such installations and to suggest how they may be eliminated. The discussion is of a general nature and is not intended to cover any particular system or make of apparatus. It should be further noted carefully that the remarks do not in any way apply to telephone systems installed or operated by public telephone companies.

Troubles Due to Poor Wiring

Poor wiring is by far the most common cause of trouble, in fact, it is safe to say that seventy per cent of all trouble can be attributed to this cause. This is not at all surprising because telephone wiring is generally treated as would be the wiring of an ordinary bell and annunciator or similar signal system. Because the wires must carry only a minute current and because of the very low voltage such wiring does not receive the same care either from the wiremen or other artisans on the job as would the electric light or power wiring. Again signal systems are not generally inspected as must be the light and power wiring. In many cases the joints are poorly made, wires are grouped together without any precaution and are often allowed to come in contact with grounded water, gas or heating system pipes. In one case of trouble which was called to the writer's attention some time ago, the wires were found to be buried for a short distance in concrete. Ordinary annunciator wire had been used. It soon rotted through and caused a short circuit between the various wires of the system. In another instance, wires had been drawn into a conduit containing water. This particular trouble was an expensive one to locate. It took three days for an electrician and his helper and the assistance of a representative from the manufacturer. The contractor making this installation originally claimed that the difficulty was due to defective or incorrectly wired instruments, whereas, as developed later, it was finally traced to careless wiring.

Common annunciator wire is the poorest that can be used for this service, in fact, for any signal system. The insulation of this wire is light and easily removed. Although paraffined it takes up moisture rapidly after having been in use for some time. Weatherproof annunciator wire is far superior to the common kind just mentioned, but the most satisfactory wire is the rubber insulated weatherproof braided twisted paired wire commonly known to the trade as "bridle wire." These wires are twisted to prevent inductive disturbances. When more than four wires are required cable is recommended in preference to individual wires. While cable costs somewhat more than the corresponding number of individual wires, it is much easier to install and makes a more substantial and better lasting installation.

A further advantage of cable is that the individual wires are of different colors, making the various circuits easy to identify and thus saving the time required to test out the circuits when separate wires are employed.

Several types of cable are available on the market. For use in dry places there is an interior cable with outside braiding treated with gray fire-proof paint. When used in dry places where it will be exposed to view a similar cable with green glazed cotton outside braiding is available. Any of the fire-proofed type of cable can be furnished lead covered and this class of cable is recommended for use inside in every case where there is apt to be moisture, even in a small degree.

In any case whether individual wires or cables are used, the wiring must be carefully done. In all cases the wiring should be properly supported and protected. If staples are used, no two wires should be secured under one staple except possibly when twisted pairs are used. Only staples having insulated heads should be permitted. Care should be taken to keep the telephone wires away from light wires or other circuits and also clear of all pipes. Special precaution is advisable when telephone wires are run in shafts with other wiring and where necessary wires or cables should be properly protected by conduit or by an equivalent means. Likewise care should be exercised when passing wires or cables through floors or walls. No wires should be placed in plaster or concrete on account of the rapid deterioration. All joints should be carefully soldered and taped with rubber tape and then covered by friction tape. All joints in twisted pair wire should be separated at least six inches.

In every installation it is good practice to install an extra wire or two depending upon the size of the system. An extra wire saves a great deal of expense in case one of the wires becomes broken and costs but very little to install. The size and number of wires will depend entirely upon the system and maximum distance between stations. This should always be determined before starting the job.

Troubles at Instruments

Next in order we may consider trouble at the instruments. These are not so frequent as to those due to defective wiring and are also much easier to correct. Trouble at the instruments may be due to wrong connections, either internally or externally. Occasionally instruments are wired wrong at the factory but more often wrong connections are made between the instruments and wires or cables of the system. Again a mistake may occasionally be made in shipping instruments for a different system of wiring or perhaps only one of the instruments is wrong. Trouble is also very likely to develop when an attempt is made to add instruments of one make to a system in which telephones of another make were originally installed. Selection of different makes of instruments to operate together should be made only by experienced persons and in no case should it be done without the approval of the manufacturer, of either one or the other make of instruments. This same question must be considered before doing a job of wiring because if the number of wires is suitable for a certain system it does not necessarily mean that the number will be correct for a similar system of another make or for a different system of the same manufacture.

Battery Troubles

Battery troubles are perhaps the most common in connection with these telephone systems, not because the battery is necessarily the weakest part of the system, but because the battery is the part most likely to be effected by any defects in the wiring or instruments that would cause a short circuit or continual drain from the batteries. When the correct number of cells is supplied and when properly installed in a cool, dry place, a set of batteries will last many months in ordinary service. This is especially true when batteries designed only for telephone or similar signal service have been provided. On the contrary when the batteries run down rapidly and the transmission is quickly effected, it is almost a sure sign that there is either a wrong connection or short circuit that is causing the battery to run down, either due to a repeated heavy current discharge from time to time, or a continuous flow of current such as would be experienced in connection with a high-resistance leak between wires or the equivalent.

A case of this kind came to the writer's attention some few months ago. A certain contractor had been called in to repair a system that had been giving trouble off and on for about three years. The difficulty was that the batteries gave out so quickly and the owner of the building became suspicious that there must be other trouble after paying the first contractor to renew the batteries so many times. The second contractor went at the job in a more systematic way. He made careful tests and soon found the batteries were under a continuous but small current discharge. After checking up the connections carefully, the trouble proved to be caused by a retardization coil which was incorrectly connected into the circuit in such a manner as to form a high resistance path across the battery leads.

The Remedy

Most of these troubles—and especially those resulting from careless wiring—can be eliminated by a little forethought when laying out the system.

The architect or engineer writing the specifications should be more specific and more careful with some of the minor details which are often overlooked but yet cause most of the trouble. He should specify the kind of system required, the number of stations, the kind of wire or cable that shall be used, the number of extra wires to be provided, and shall insist upon a suitable place for the batteries. He should then have the wiring carefully inspected before the wires are covered and know that his specifications have been followed. He should further insist that a diagram showing in detail the scheme of connections be posted in some convenient and accessible place so that in case of trouble the wires can be easily traced out and identified. This diagram should show the manufacturers' number or some equivalent designation which would enable him to identify the system if called later for assistance or suggestions.

Further, the contractor should be required to guarantee and keep the system in order for at least one year. This requirement will tend to eliminate those bidders who are inclined to do poor work but will not in any way work a hardship on the reliable contractor.

The contractor receiving the job should consult with the manufacturer regarding the installation unless he or his men have wide experience in this line. An hour spent in this way will be very beneficial to all concerned. The manufacturer can point out certain features about the system, supply suitable wiring diagrams and instructions and in many cases can make suggestions that will save time and money for the contractor.

FUEL OIL AND STEAM ENGINEERING

(Recent advances in fuel oil practice require that the engineers constantly bear in mind the particular design and classification of the boiler under consideration in order to produce the best economic results in steam generation. In this discussion the authors first give the fundamental requirement for boiler installation in modern power plant design and then discuss a number of the more prominent types of commercial boilers found on the market. In closing, the leading characteristics of marine boilers as distinguishing them from stationary boilers are set forth.—The Editor.)

BOILER CLASSIFICATION IN FUEL OIL PRACTICE

BY ROBERT SIBLEY AND CHAS. H. DELANY

A Battery of Fifteen Boilers oil-fired, requiring but Two Men for Their Operation

IN the generation of steam by the tea-kettle the cycle of operations through which the water and steam pass is quite simple. The heat applied at the bottom of the tea-kettle is absorbed by the water along its surface exposed to the heat application. As this heat is absorbed the water is raised in temperature and due to its immediate expansion becomes lighter than the water above it and consequently passes to the top to allow cooler water to descend, which in turn becomes heated and passes to the top to make way for still other water to become heated. This cycle of operations continues and finally evaporation takes place. The steam thus generated passes to the atmosphere without.

In the modern high pressure steam boiler the operation is somewhat more complicated. The water circulation proceeds on the same general principle but since steam generation is the important function and not merely the supplying of hot water as in the tea-kettle, some space must be provided wherein to store the steam that is generated. This is usually accomplished in the space above the water level in the main boiler shell or drum. If superheated steam is to be produced, the saturated steam is conveyed from this space into pipes known as a superheater. These pipes are exposed to the hot furnace gases and the steam passing through them readily absorbs heat, thus superheating the saturated steam to any temperature determined upon.

The Boiler Drum and Tubes.—It has been mentioned that the tea-kettle is a most inefficient boiler and so it is. While mechanical stresses and strains involved necessitate the employment of cylindrical shells for boilers, still the boiler itself resembled in the early days of the steam engine but slight variations from the tea-kettle.

It soon became apparent, however, that the actual surface exposed to the heated gases of the furnace has much to do with efficient steam generation. Hence while the first type of boiler was made in a solid shell, variations from this standard soon made their appearance. Let us now examine some of these types.

Internally and Externally Fired Boilers.—In the earlier type of boiler the fire was kindled beneath the solid cylindrical boiler shell. Such a type became known as an externally fired boiler. Later the boiler compartment was hollowed out and the fire kindled inside this hollow space, thus introducing the internally fired type. The locomotive boiler is today an illustration of this type of boiler.

The Return Tubular Boiler.—Another type soon developed wherein the fire was kindled beneath and the flue gases returned to the front part of the boiler through a series of flutings or tubes passing through the main part of the boiler shell. Such a boiler became known as a return flue boiler or return tubular boiler depending upon whether or not the tubes or flutings exceeded six inches in diameter—the flue being the larger diameter and the tube the smaller.

The Fire Tube and the Water Tube Boiler.—A great many types of boilers finally made their appearance on the market in some of which the fire passed through the tubes which were surrounded by water in the boiler shell, and in other instances the water passed through the tubes around the external surface of which the heated gases were made to pass. The former became known as fire tube while the latter were called water tube boilers. It is generally conceded that where rapid steaming is required the latter type is far preferable.

It is now universally the custom to use water tube boilers in all large stationary power plants, the principal reasons the following:

1. Small floor space required.
2. Greater safety at high pressures due to the small diameter of the drums and tubes.
3. Greater flexibility so that expansion strains are not injurious, permitting
4. Rapid steaming and sudden change of load.

Tubular boilers still have their field in small one man plants, where owing to the large quantity of water contained in the shell they maintain a uniform pressure with but little attention.

Tubular boilers of the Scotch marine type are still extensively employed in marine work where owing to the steadiness of the load they have met with great success.

Vertical and Horizontal Types.—Still other classifications are made based upon whether the tubes and boiler shell be in a horizontal or vertical position, the former being called, as one would presume, the horizontal and the latter the vertical type of boiler. As time went on still other boilers appeared which could neither be called horizontal nor vertical but an intermediate classification became necessary.

Let us now examine two types of boiler used in the modern central station in order the more clearly to grasp the fundamentals of boiler design and principles of operation.

Illustrations of Principles of Construction and Operation.—Before proceeding to the brief description of these two types of boiler, the reader must bear in mind that these particular two are picked as best setting forth principles of construction and operation, and not necessarily as a preference for commercial installation. Many types of boiler are today upon the market and in their separate and distinctive features such possess characteristics that must be carefully considered in making a commercial choice. With this understanding let us then proceed to examine these two boiler types of commercial practice.

The Babcock and Wilcox Boiler.—By a close examination of the illustration as shown herewith the Babcock and Wilcox boiler is seen to be composed of one or more horizontal shells or drums from which are suspended a series of inclined tubes.

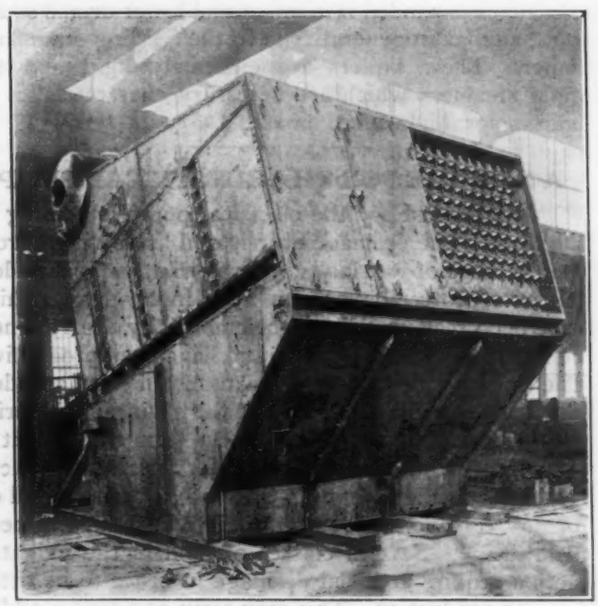
In this type of boiler installation the oil burner is located in the rear of the furnace and the fuel oil is shot forward toward the front; thus this type is known as the "Back-shot" type of installation. The heated gases then pass upward and around the tubes through what is known as the first pass. At the top of this pass the heated gases envelop the lower half of the boiler shell and are then diverted downward through and around the superheater tubes shown immediately below the drum until the journey through second pass is completed. At the rear of the furnace wall they are once again diiverted upward through the third pass and then after contact with the boiler shell, they are conveyed out through the breeching up the stack or chimney. In this manner the heated gases are brought into intimate contact with the water tubes and efficient steam generation accomplished.

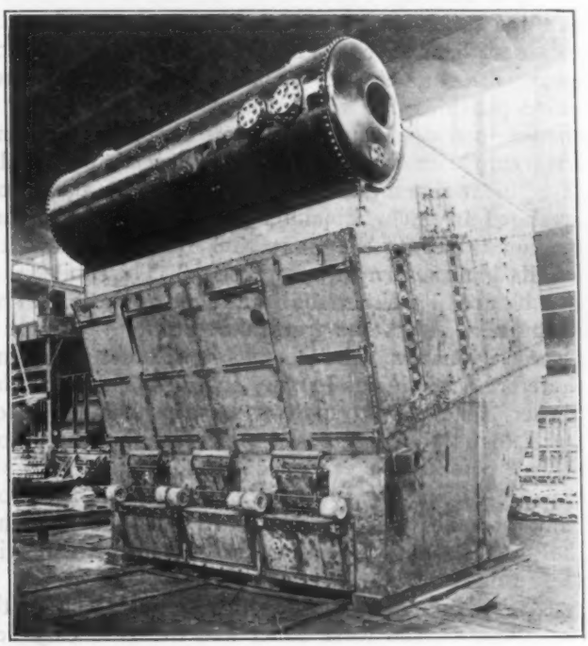
Water Circulation.—The water for steam generating purposes is introduced through the front drumhead of the boiler. It then passes to the rear of the drum, downward through the rear circulating tubes to the sections. Then it courses upward through the tubes of the sections to the front headers and through these headers and front circulating tubes again to the drum where such water as has not been formed into steam retraces its course. The steam formed in the passage through the tubes is liberated as the water reaches the front of the drum. The steam so formed is stored in the steam space above the water line.

The Parker Boiler.—Another type of boiler which is exceedingly interesting, as its operating principles are almost diametrically opposite to the foregoing is that of the Parker boiler.

As seen from the illustration, the fuel oil is shot from the front of the furnace to the back. The heated gases in their journey toward the rear come in contact with the lower set of tubes and at the rear they pass up through the superheater. They are then deflected back horizontally toward the front, passing parallel along the water tubes. At the front they return again to the rear along the third set of tubes and also along the lower half of the boiler drum above.

Water Circulation.—Water enters the upper set of horizontal tubes from the front without passing first into the boiler drum above. At the rear it is conveyed upward into the drum which has a longitudinal diaphragm separating the steam section above from the water section beneath. This water having emptied upon the diaphragm in the upper compartment flows down along the diaphragm to the front. At this point it is dropped down into the next section of tubes to be again discharged upward into the upper rear section to flow again down along the diaphragm to the front and again to be lowered into the lowest section of hori-



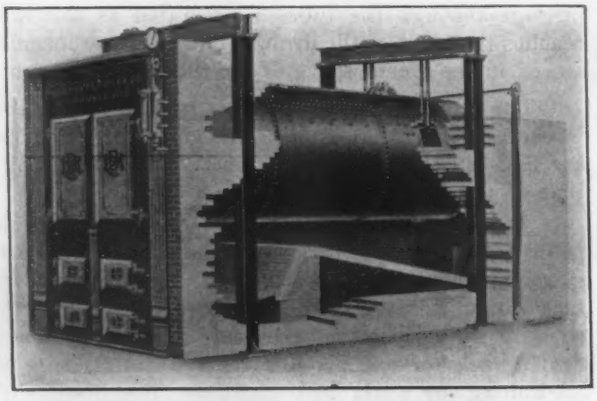


THE B. & W. MARINE TYPE OF BOILER—REAR AND FRONT VIEW

Water tube boilers for marine service are built as modifications of both the B. & W. and the Heine type, the tubes being shorter and smaller in diameter than is the case in stationary boilers. The boilers are encased in steel, lined with light insulating material inside, instead of being set in brick. They are constructed of the highest grade of forged steel. Marine boilers frequently carry pressures as high as 300 lb. per sq. in.

zontal tubes to return into the diaphragm section above as saturated steam.

It is seen by comparing those two types of steam generation that contrary and opposite theories are used. The first fires the oil flame from the back



A Milwaukee High Pressure Horizontal Tubular Boiler with Full Front and Suspension Setting

toward the front, while the latter applies the opposite process. The first admits the water into the drum and then produces a water circulation from the lower sections upward; the latter takes the water first through the top sections and winds up at the lower. The first sets forth the theory of right angle impingement of heated gases against the water tube surface while the latter takes the paralleling flow theory. The remarkable thing about the whole comparison is that both have produced wonderfully efficient steam generating achievements in carefully conducted fuel oil tests on the Pacific Coast.

The Stirling Type.—The Stirling boiler consists of three steam drums connected to one mud drum by means of bent tubes. The bending of the tubes does away with the necessity of using headers and furthermore provides for expansion of the tubes due to change in temperature. As a result this boiler is not only simple in design but very flexible and capable of withstanding a good deal of abuse. The baffles are arranged in such a manner that the gases of combustion travel up the front bank of tubes, down the middle bank and up the rear bank. This boiler may also be fired by either the front shot or the back shot oil burner. With the front shot burner the flame is forced right among the front bank of tubes which are, therefore, effective as heating surfaces. The back shot burner has the advantage of shooting the gases forward to a large combustion chamber so that more perfect combustion can be obtained, although at the expense of making the heating surface of the front bank of tubes less effective owing to the fact that the gases do not come in such intimate contact with these tubes.

Other boilers of the general Stirling type are the Badenhausen, the Rust boiler and the Erie City vertical boiler.

The Heine Type.—The Heine boiler is a horizontal water tube boiler similar to the B. & W. boiler except that instead of having separate headers the tubes are all expanded into a single water leg at the rear and another at the front. These water legs have large flat surfaces which have to be strengthened by stay bolts. Owing to the fact that all of the tubes are connected to the same water legs, this boiler is not as flexible as the other two types described above. The Heine boiler is usually provided with horizontal baffles so that the gases of combustion pass first to the rear of the boiler and then forward among the tubes and then back again. With this arrangement of baffling the front shot oil burner introduced through the front wall is very successful. Other boilers of the Heine type are the Keeler and Edgemoor boilers.

Marine Boilers.—For mercantile marine service the standard boiler for many years has been the Scotch marine boiler which is a fire tube boiler consisting of a large shell within which are placed corrugated furnaces, a combustion chamber at the rear and tubes running forward from the combustion chamber to the front of the boiler, whence the gases pass through the uptakes to the smokestacks. Owing to the large size of the shell, Scotch boilers are made of excessively thick steel and consequently are entirely lacking in flexibility. They are, therefore, liable to give trouble due to expansion strains from change in temperature and are successful only where the load is absolutely steady as it is on ordinary merchant ships.

In the navy water tube boilers are used exclusively and these are coming into use more or less in the mercantile marine as well.

Water tube marine boilers are built as modifications of both the B. & W. and the Heine types, the tubes being shorter and smaller in diameter than is the case in stationary boilers and the boilers being encased in steel, lined with light insulating material inside, instead of being set in brick.

For torpedo boat destroyers and other small high speed craft, boilers of the Thornycroft type are used, which consist of a large number of very small diameter tubes expanded into upper and lower drums somewhat similar in general type to the Stirling stationary boiler. These boilers are extremely light and are rapid steamers which are necessary characteristics of boilers for high speed boats.

A NEW USE FOR THE ELECTRICAL PUMP

Another use for the electrical pump is coming to the front. The drainage of irrigated lands differs from the drainage of wet lands generally in that it is undertaken to protect or reclaim from injury lands which have been reclaimed from their naturally desert condition at considerable expense and have been productive. The drainage of such land means not merely an addition to the productive area but the saving of the original investment in such land in the farm of which it is a part and in the water supply for irrigation. Practically every valley where irrigation has been carried on for any considerable length of time has lands in need of drainage. Several classes of land in the irrigated section require artificial drainage in order to be fitted for crop production. This may serve as a tip for added electrical loads now utilized in irrigation districts. Farmers' Bulletin 805 of the U. S. Department of Agriculture entitled, the Drainage of Irrigated Farms will be found most helpful for suggestions along these lines.

SPARKS—Current Facts, Figures and Fancy

(Electricity is playing the leading role in present day world problems. As to how economies are being effected by its use and new prossibilities of victory assured by its further development the reader will glean from the briefs on this page. Other interesting notations on world events and progress of the industry will also be found in the following notations.—The Editor.)

Even the method electrical has invaded the ballot system. The Argentine Embassy at Washington announces that bids are invited by the Argentine government for the designing, manufacture, and installation of an electrical voting machine for the Chamber of Deputies of Argentina.

* * *

It is not yet too late for the Federal government to avert the threatened fuel famine in California, but relief legislation must be enacted quickly if disaster is to be avoided. This is the view of well informed captains of industry in the Golden State who say that consumption of crude oil in California is now sixty thousand barrels a day above production.

* * *

English technical journals are advocating the development of the water powers in the British Isles as the means of a possible saving of twenty thousand tons of coal a year. Think of six millions of barrels of oil that can be immediately saved in California alone by reasonable legislation on water power as set forth in the Journal of Electricity August 1, 1917!

* * *

The State of California is a good farmer. A cow owned at the state farm yielded 94 pounds of butterfat during the month of June. Possibly the electrical appliances available on the farms of the West may even be reflected in the contentment of cows and their consequent increased yield. Ask the power salesman, he knows.

* * *

Herbert Hoover's six big requests for food conservation are to eat one wheatless meal a day; to eat beef, mutton or pork not more than once a day; to economize in the use of butter; to cut the daily allowance of sugar in tea or coffee and in other ways; to eat more vegetables, fruit and fish; and to urge in the home or the restaurants frequented the necessity of economy.

* * *

It is interesting to note that the Argonaut mine, located on the Mother Lode at Jackson, Amador County, and supplied by electric service from the Pacific Gas & Electric lines, has the distinction of having the deepest shaft of any gold mining property on the North American continent, having now reached a total lineal depth of 4667, which corresponds to a vertical depth of 4650 ft.

* * *

The war in Europe is forcing upon the allies the uses of electricity that have long been advocated in the West. The French government has issued a decree prohibiting the use of gas from 8:30 a. m. to 12:30 p. m., from 2 to 5:30 in the afternoon, and from 9 at night until 4:30 in the morning. Electrical engineers are instructed, says Reuter, to endeavor to find means of substituting electrical energy for steam engines in factories.

* * *

The manganese situation is most encouraging as the United States Geological Survey estimate for the whole year is 80,000 tons of the high-grade ore. This however, is less than 20 per cent of the present large demand of the steel industry. Yet it is significant that the shipments of lower grade manganese ore likewise are record breaking, the 6 months of 1917 considerably exceeding the 12 months of 1916, and the present rate of production promises an even larger tonnage for the remaining 6 months.

* * *

As an instance of the unique work ahead for the engineer, may be cited the recent words of Secretary of War Baker before the Society for the Promotion of Engineering Education: "Nobody knows how long this war is going to last, but we do know that when the war is over the rehabilitation of a stricken, if not paralyzed civilization, is going to be a long-drawn-out and uphill task and there will be need on every hand for trained minds, for trained and schooled men. The day of the engineer will be indeed the big day."

* * *

Present day emergency service of a great utility company is interesting. On July 4th, fire destroyed all the apparatus in the compensator room at Los Angeles number three and two generators burnt up at the Big Creek plant, reducing the hydraulic capacity of the Southern California Edison Company by 32,000 kw. In connection with this latter burn-out it was necessary to get new coils to the plant in the quickest possible time. To do this a one-ton truck with two drivers was dispatched from Los Angeles at noon time with the desired apparatus and arrived at the plant 285 miles distant, at 6:25 a. m., the following morning.

* * *

In a recent article in the Electrical World, Mr. Hugh L. Cooper estimates that if the wasted 35,000,000 h.p. of water power were developed the country would be $1,241,600,000 the gainer every year, or nearly $36 per horsepower. Mr. Cooper has made a serious error in his assumptions, according to Engineering and Contracting, for if we capitalize the $36 at 10 per cent we get $360 as the value of each horsepower of water rights, which is certainly from four to ten times too great. Nevertheless, it is incontestable that a vast sum is annually going to waste because of injudicious government action, both state and federal, the latter through a restrictive and narrow policy of so-called "conservation," the former through failure to be liberal enough in the rate-making policies.

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SUCCESS IN ORGANIZATION

When in the running of the affairs of a nation, or in the building of an executive organization, or in the grouping of the family responsibilities, or in the harmonizing of Capital and Labor, or even in the daily routine of each human life, it becomes a recognized fundamental of human activity that responsibility and authority are as inseparable as the feldspar, mica and quartz that make the strength of the granite, then indeed may such effort be said to be in line for its due measure of success.

PUBLISHER'S ANNOUNCEMENT

W. M. Deming has joined the managerial staff of the Journal of Electricity as Vice-President and Business Manager of the Technical Publishing Company. After 29 years of service with the General Electric Company Mr. Deming, as announced in the technical press throughout the country, resigned his position the first of the year, in order to come to the Pacific Coast for a much needed rest and recreation.

He has become so thoroughly imbued with the life, the spirit, and the enthusiasm of the Great West that he has decided to remain with us and this announcement of his connection with the Journal of Electricity constitutes the greatest single advance ever made in the forward progress of the Journal.

We confidently feel that his helpful presence in the affairs of the electrical industry throughout the West means much for the continued prosperity and growth of the Journal in its contribution of usefulness to the nation.

Why it Looks Good in the West

There is no denying the fact that an increasing sense of optimism is being felt throughout the West. While much of the gigantic industrial activity that is going on may be directly traceable to war orders, still those who look deeper realize that the wheels of industry that are now being set in motion have a permanent tinge to them.

The West has long needed manufacturing and industrial growth to give balance to its vast agricultural and water power resources. It is fully realized that every resource of the nation is pledged—life and soul—to bringing a successful termination to the present world war and in its contribution to this task the West is giving of its all.

But the dark war cloud certainly has its silver

lining. Out from beneath its apparently dark and grewsome forebodings, men of constructive vision see a tremendous era of commercial and engineering activity ahead, unrivalled in its splendor.

The lesson of the war is a timely one for development in the great Pacific Area. The realization that domination must cease in all commercial and engineering activity of the future, the part that Western effort must perforce play in the era ahead will be in the spirit of co-operation and helpfulness in assisting foreign neighbors of the Pacific Area in their forward moves.

So apparent is this call to the new West and so fascinating are its allurements that manufacturers, manufacturers' agents and engineers are already laying their plans in these strenuous times to be ready on the morrow for this new era of commercial and engineering activity as its reactive force will be felt throughout the West in vastly forwarding its industries and the development of its natural resources.

The Conventions in September

The interest that is being shown in all quarters looking toward a goodly attendance at convention gatherings that are scheduled for September is most gratifying.

A special car from California via Portland to the Spokane convention of the Northwest Electric Light & Power Association is now assured. It is hoped that it may prove to be a special train such is the enthusiasm that prevails.

A convenient arranging of the dates of other conventions of the month has been so prepared as to avoid conflicts the one with the other. Thus the British Columbia Association of Electrical Contractors and Dealers has its convention at Vancouver, B. C., September 10 and 11; the Northwest Electric Light & Power Association convenes at Spokane, Wash., September 12, 14 and 15; and the Oregon Association of Electrical Contractors & Dealers holds forth at Eugene, Oregon, Septemer 17 and 18. Hence it is possible for those who so desire to go the round of the circuit and attend them all.

In these times of tense activity it is well that men of the industry get togther and discuss matters of grave and timely interest to all. The Journal of Electricity bespeaks a goodly and enthusiastic attendance for them all.

When Patience Ceases to be a Virtue

In the continued struggle between the municipally owned and privately owned utility the public often is forced to undergo inconveniences that not only frequently prove nuisances but at times a menace to its welfare and safety.

The congested condition of the traffic in the main business arteries of the larger cities of the West is itself a problem difficult of solution even with a free hand to proceed in an investigation unhampered by local influences and color.

Take for instance the traffic situation on the principal business thoroughfare of one of the larger cities of the West at the present time. This thronged street already has four parallel tracks through several blocks of its congested district and yet it is now proposed to force upon the city an extension of this hazardous and unscientific system for many blocks further.

As to how long the people will stand for such unwise and unsafe procedure remains to be seen, but certainly there is a point where patience ceases to be a virtue. In such questions as these engineers of the West, skilled in analysis and methods of public betterment, should exercise every influence possible to see that the issue is determined solely on its economic value, devoid of political intrigue, or partisan flavor.

The Raising of Rates on Transportation

On another page of this issue, Mr. C. E. Grunsky, a well known authority on rates, in a notable contribution of articles to the Journal of Electricity, states that one among many other demands an owner of a utility has the right to make is that it be allowed a share in the general prosperity which this utility has helped to create.

The past semi-monthly period has witnessed a distinct sensation throughout various communities of the West where applications have been filed with the regulatory bodies looking toward a raising of the suburban and interurban transportation rates.

In the past, the travelling public in the West have lauded and praised to the skies the lavish hand with which equipment and service have been installed to serve them.

Many residents can look back to but a few years when the loud puffing steam locomotives and their wornout rolling stock trailed their way through unkempt streets that lined the right-of-way of at least one of these institutions. A half day's travel over the present flower-lined rights-of-way upon the latest design in car equipment in this district today gives a decidedly different appearance to the picture.

It is true that the establishment of zones or the increasing of rates will unbalance the present and future building of communities and their relationship to other districts served. This very fact in itself is proof positive that the utilities involved have helped to create the general prosperity of the communities served and as a consequence they should be allowed a share in this general prosperity.

The regulatory bodies before whom these hearings are to take place have indeed a delicate issue at hand, but it is believed that utmost fairness and a strict adherence to fundamental economic principles of utility regulation will prevail.

Commercial and Engineering Growth in China

Recent consular reports from China show an interesting growth in commercial and engineering relations with the United States. Regardless of the war, the gross trade of Shanghai in 1916 was greater than in any previous year. The direct foreign commerce also surpassed by nearly $50,000,000 that of 1913, the previous record year. The increase in 1916 was more than $100,000,000 over 1915 and somewhat less over 1907, a steady advance in trade having continued until war conditions checked it in 1914. This interference has been largely overcome, and further gains in Shanghai's extensive commerce are anticipated. The port transacted more than 42 per cent of the total foreign trade of China in 1916 —$348,689,907 out of $826,812,672.

In 1916 for the first time the United States took the lead in the aggregate trade between Shanghai and

any one country, England and Japan ranking second and third, respectively. The United States bought more Chinese products in 1916 than any two other countries combined. If ships had been available to transport freight at reasonable rates the total of American-Shanghai commerce in 1916 would have been much greater. During the year many more American manufacturers and exporters established connections in Shanghai and some sent their personal representatives to investigate conditions or to co-operate with their appointed agents. Several prominent American firms opened offices here.

An Overpowering Argument for Interconnection

That as much as a half billion dollars worth of coal annually goes to waste in the United States due to inefficient utilization of this great natural resource is easily seen by a comparative study of power plant efficiencies that may be obtained in the larger as compared with the smaller installations. In the larger plants the efficiencies may be as high as 15 to 18 per cent while in the small pawer station the efficiency drops below 10 per cent. According to the director of the U. S. Bureau of Mines there was mined in the United States last year the enormous total of six hundred million tons of coal, the greatest production ever witnessed in the world. A study of average plant efficiencies the country over reveals the fact that their average efficiency is only somewhere in the neighborhood of 5 or 6 per cent. Thus it is easily seen that were it possible to elevate the average efficiency to something near the maximum now attainable in steam plants about three times as much energy would be available for the productive industries of the country.

This study of conservation of fuel becomes especially interesting when conditions in the West are carefully noted. Fuel oil is used universally in this district when steam power is necessary to be used as an auxiliary to hydroelectric power.

A perusal of the economic results set forth in the leading article of this issue on the Inspiration Copper Company is interesting. This plant is producing the remarkable result of an average net efficiency of the boiler and economizer, even after deducting the steam used for atomizing, of 82.9 per cent. A twelve month average of nearly 286 mean kw.-hrs. per barrel of oil is shown in the power plant statement, and an overall thermal efficiency of the plant as a whole for last December with a machine load factor of 82.5 per cent was 16.32 per cent. On the other hand a recent power plant statement from the new Ajo power plant in Arizona, indicates 312 kw.-hr. per barrel of oil and consequently an even larger over all efficiency.

That these larger stations are thus able to produce such vastly better economic results than the smaller plants points clearly to the necessity of gigantic networks of interconnection in every manner reasonably possible. It means utilization of hydroelectric power in its highest development and when this is exhausted, the burning of fuel.

An Economic Pointer for Tunnel Lining

The unfortunate experience encountered due to the non-lining of certain of the tunnel work along the Los Angeles Aqueduct first led engineers to question the advisability of ever again undertaking the completion of permanent work of this character without properly lining the tunnel bore with concrete.

The building of the mammoth Twin Peaks tunnel, now recognized as the largest and longest tunnel ever undertaken in a municipal effort, has enabled engineers of the city of San Francisco to study the economic factors that enter into concrete lining.

An interesting application of their deductions is found in a careful study of the proposed tunnel work for the Hetch Hetchy project soon to be let under contract. Nearly nineteen miles of this work are now being advertised and although the alignment passes through some of the hardest and most durable of rock formations, still the work is to be concrete lined throughout.

When it is considered that nearly twice the area of cross-section must be excavated in order to concrete a tunnel of the dimensions proposed, one is at first led to speculate as to why the extra expense. It is said, however, that careful experiments have led the city's engineers to the conclusion that the extra friction of the unlined tunnel would cause such an increase in tunnel section as to make the concrete lined tunnel of more economic value even when all other resultant desirable factors of the concrete lining is not taken into consideration.

THE NEW JOURNAL SERVICE: In line with its whole-souled ideal of service to the electrical industry in the West, the Journal of Electricity has furnished a room in its suit of offices at the Crossley Building in San Francisco, which it will reserve for the especial use of its readers and friends who happen in at its headquarters from time to time. It is sincerely hoped that all visitors, either from the East or from any of the territory it serves in the West, will not fail to add their name to the register of guests that is being kept and that all will co-operate with the Journal in this move, for furthering the splendid esprit de corps that is now so firmly entrenched among men of the electrical industry in the West.

In editorial matter for the coming issues, especial emphasis is to be laid upon the doings of electrical men in the great northwest and the forthcoming convention at Spokane. Full details in the next issue will be given concerning the convention. The issue of September 15, 1917, will contain a beautifully illustrated article on the Bunker Hill & Sullivan mine, which is to be the feature for visitation during the convention.

The articles on rates by C. E. Grunsky, the well-known consulting engineer, which are receiving such favorable comment in the technical press, will be continued from a new phase of discussion in the issue of September 1, 1917, and for several issues thereafter.

Other departments will be continued with especial attention in adaptation to the needs of the immediate present in the electrical industry.

PERSONALS

O. B. COLDWELL, superintendent of the Portland Railway Light & Power Company, as the chairman of the executive committee of the Northwest Electric Light & Power Association, is actively engaged in arranging for the many details that have to do with the success of the forthcoming convention of the association in Spokane, September 12-15, 1917. As a past president of the association, Mr. Coldwell has long been an active figure in the advance of the electrical industry in the Northwest. During the Riverside convention of the Pacific Coast Section, N. E. L. A., he was the official guest from the Northwest and it is largely due to his cordial presence at this gathering that so much interest has been aroused in returning a goodly attendance of visitors from the states to the south to the Spokane convention.

A. H. Halloran, formerly managing editor of the Journal of Electricity, has been appointed assistant business manager.

J. F. NePage, of NePage, McKinney Company, electrical engineers and contractors of Seattle, recently made a business trip to San Francisco and Portland.

Theo. N. Vail, president of the American Telephone & Telegraph Company, is a recent visitor at San Francisco and attended the high jinks at Bohemian Grove.

J. H. Prior, formerly chief engineer, Illinois Public Utilities Commission, has left the service of the Illinois Commission to open an engineering office in Chicago.

H. B. Peirce, assistant commercial agent of the Washington Water Power Company at Spokane has resigned his position in order to engage in commercial and engineering activity in Russia.

Scott Hendricks of San Francisco, president of the Oregon-Nevada Telephone Company, has accepted service with Herbert Hoover in his food control administration work during the period of the war.

C. B. Merrick has resigned his position in the distribution department of the Pacific Gas & Electric Company to accept service with the research department of the Rieber Laboratories of San Francisco.

F. W. Gay, a consulting engineer of San Francisco and the Pacific Coast Correspondent of the J. G. White Engineering Corporation, is again back at San Francisco after an extended business trip in the East.

A. R. Thompson, in charge of the distribution department of the Pacific Gas & Electric Company, in San Francisco, has resigned in order to accept a position as a captain in one of the engineer regiments of the United States Army.

T. W. Simpson, western manager of the Federal Sign System (Electric) is again at his San Francisco office, after a delightful trip to St. Joseph, Mo., where his company held a recent business and social gathering of its district managers.

T. C. Roberts, chief engineer of the United Verde Copper Company and of the United Verde & Pacific Railway Company at Clarkdale, Arizona, has been transferred to the grade of member in the American Institute of Electrical Engineers.

A. G. Wishon, general manager of the San Joaquin Light & Power Company, is a recent San Francisco visitor, and reports that two new hydroelectric plants of his company on the Kern River will be placed in operation within the next thirty days.

M. F. Steel, Pacific Coast manager of the Benjamin Electric Manufacturing Company, has left for Chicago and will return westward again in time to go direct to the convention of the Northwest Electric Light & Power Association at Spokane in September.

Ray W. Turnbull of the General Electric Company's office at Portland, is a recent San Francisco visitor and reports that continued live interest is being shown in the Northwest in heating appliances and their relationship with central station advance in the Northwest.

E. P. Warner, formerly chief engineer of the Chicago works of the Western Electric Company, now a resident of San Diego, is a recent San Francisco visitor. Mr. Warner was one of the judges of awards at the World's Exposition in Chicago in the class of heating and welding.

J. C. Carlson of the Central Electric Company has returned to San Francisco from a six weeks' visit in the East during which journey he had an interesting interview with **W. L. Goodwin,** formerly of the Pacific States Electric Company and now engaged in forwarding co-operative work among the electrical contractors in New York City.

Newcomb Carlton, president of the Western Union Telegraph Company, is a visitor on the Pacific Coast. Mr. Carlton was a much interested spectator at a recent spectacular review of many of his company's men now training in the signal corps battalion at Monterey Presidio under the command of **Major A. H. Griswold,** formerly plant engineer of the Pacific Telephone & Telegraph Company.

J. A. Lighthipe, electrical engineer for the Southern California Edison Company, has made unusual progress in safety engineering for his company. The number of accidents of any serious moment has been reduced enormously during the past two years. There was but one fatal accident last year, and this was due more to the physical condition of the man than to anything else, he having a weak heart.

BUILDERS OF THE WEST—X

E. C. JONES

The discovery of such vast resources of crude petroleum in California as to equal twenty-five per cent of the world's output in this product, led engineers of the West to formulate new uses and originate new inventions for its economic utilization in the industries and in the domestic life of the West. To E. C. Jones, chief gas engineer of the Pacific Gas & Electric Company, must be recorded the credit of an ingenuity in gas engineering that places him pre-eminent as a Builder of the West in this field of endeavor.

But the younger generation gains especial inspiration by recalling as a motto for higher effort the beautiful words of Mr. Jones at the San Diego Convention of the Pacific Coast Gas Association: "A man may be said to have acquired success when he has helped another attain what he himself has missed."

Emmett Callahan, Jr., of Broadman, Oregon; **G. G. Fitzgerald**, Ventura County Power Co.; **J. L. Frye**, of Bisbee, Ariz.; **D. W. McCleery**, of NePage, McKenny Co., Great Falls, Mont.; **G. B. Sanford**, of the Great Western Power Co.; **William Sydow**, Denver, Colo.; **W. H. Tolhurst**, of the Standard Oil Co.; **G. F. Wilson**, of the Los Angeles Railway, have been elected associate members of the American Institute of Electrical Engineers.

OBITUARY

George Ey, auditor of the General Electric Company at Los Angeles, passed away Thursday, August 2, 1917.

DIRECTORY

Officers and Committees, Pacific Coast Section National Electric Light Association, 1917-1918

Officers

President, H. F. Jackson, Sierra & San Francisco Power Co., San Francisco.
Vice-president, Samuel Kahn, Western States Gas & Electric Co., Stockton, Cal.
Vice-president, E. R. Davis, Southern California Edison Co., Los Angeles.
Secretary, A. H. Halloran, Journal of Electricity, San Francisco.
Treasurer, A. N. Kemp, Southern California Edison Co., Los Angeles.

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Henry Bostwick, Pacific Gas & Electric Co., San Francisco.
W. W. Briggs, Great Western Power Company, San Francisco.
Wm. Baurhyte, Los Angeles Gas & Elec. Corp., Los Angeles.
George A. Campbell, Truckee River Gen. Elec. Co., Reno, Nev.
D. E. Harris, Pacific States Elec. Co., San Francisco.
H. C. Reid, Pacific Fire Extinguisher Co., San Francisco.
W. P. Southard, Albuquerque Gas, Elec. Light & Power Co., Albuquerque, New Mexico.
F. S. Viele, Prescott Gas & Electric Co., Prescott, Ariz.
K. E. Van Kuran, Westinghouse Elec. & Mfg. Co., Los Angeles.
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J. M. Shepard, Deming Ice & Elec. Co., Deming, New Mexico.
J. G. Scrugham, Elko-Lamoille Power Co., Elko, Nevada.
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L. M. Klauber, San Diego Cons. Gas & Elec. Co., San Diego.
C. O. Poole, Southern Sierras Power Co., Riverside, Cal.
W. C. Hornberger, Pacific Gas & Electric Co., Phoenix, Ariz.
S. J. Lisberger, Pacific Gas & Electric Co., San Francisco.
R. E. Cunningham, So. California Edison Co., Los Angeles.
E. R. Northmore, Los Angeles Gas & Elec. Corp., Los Angeles.

Commercial Committee

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J. B. Black, Great Western Power Co., San Francisco.
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E. B. Walthall, San Joaquin Lt. & Power Corp., Fresno, Cal.
E. B. Criddle, So. Sierras Power Co., Riverside, Cal.
G. R. McLean, Pacific Light & Power Co., Riverside, Cal.
A. E. Halloway, San Diego Cons. Gas & E. Co., San Diego, Cal.
C. M. Einhart, Roswell Gas & Elec. Co., Roswell, New Mexico.
R. M. Alvord, General Electric Co., San Francisco.
Miles L. Steel, Benjamin Elec. Mfg. Co., San Francisco.
W. S. Berry, Western Electric Co., San Francisco.
M. L. Scobey, Home Electrical Co., San Francisco.
H. L. Aller, Pac. Gas & Elec. Co., Phoenix, Ariz.
H. J. Kister, Los Angeles Gas & Elec. Corp., Los Angeles.

Accounting Committee

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C. D. Reid, Pacific Gas & Electric Co., Phoenix, Ariz.
W. E. Shaw, Jr., Truckee River Gen. Elec. Co., Reno, Nev.
C. E. Twogood, Albuquerque Gas & Elec. Co., Albuquerque, New Mexico.
P. R. Ferguson, So. Sierras Power Co., Riverside, Cal.
A. B. Carpenter, San Joaquin Lt. & Pr. Corp., Fresno, Cal.
R. B. Stith, Western States Gas & Elec. Co., Stockton, Cal.
F. J. Blanchard, Sierra & S. F. Power Co., San Francisco.

Membership Committee

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H. S. Batchelder, Western States Gas & Elec. Co., Stockton, Cal.
R. E. Frickey, Northern Cal. Power Co., Redding, Cal.
W. S. Leffler, Great Western Power Co., San Francisco.
W. H. Talbot, San Diego Gas & Elec. Co., San Diego, Cal.
H. N. Sessions, So. California Edison Co., Los Angeles, Cal.
H. P. Pitts, Pacific Gas & Elec. Co., San Francisco.
C. F. Butte, Butte Engineering & Elec. Co., San Francisco.
J. M. Buswell, San Joaquin Lt. & Power Co., Fresno, Cal.
C. A. Kelley, So. Sierras Power Co., Riverside, Cal.
Edward C. Russell, Tucson Gas, El. Lt. & Pr. Co., Tucson, Ariz.
J. B. Mechling, Nevada-Cal. Power Co., Goldfield, Nev.
C. B. Hall, Illinois Electric Co., Los Angeles.
J. R. Buchanan, Silver City Power Co., Silver City, N. M.
E. F. Sells, Albuquerque El. Lt. & Pr. Co., Albuquerque, N. Mex.
Paul V. Quick, Landers, Frary & Clark, San Francisco.
B. G. McBride, Elko-Lamoille Power Co., Elko, Nev.
R. S. Arthur, Douglas Traction & Lt. Co., Douglas, Ariz.
J. C. Rendler, So. Cal. Electric Co., Los Angeles.
J. E. Cornell, The Arizona Power Co., Prescott, Ariz.
A. E. Youngholm, Elec. Ry. & Mfrs. Supply Co., San Francisco.
H. E. Sanderson, Bryant Electric Co., San Francisco.
A. B. Day, Los Angeles Gas & Elec. Co., Los Angeles.
J. V. Case, General Electric Co., Los Angeles.
Robert Sibley, Journal of Electricity, San Francisco.
A. E. Morphy, So. Cal. Edison Co., Los Angeles.
R. S. Masson, Arizona Power Co., Prescott, Ariz.
Geo. B. Furniss, Pacific Gas & Electric Co., Oakland, Cal.
W. S. Coleman, Pacific Gas & Electric Co., San Francisco.
L. F. Galbraith, Pacific Gas & Electric Co., San Francisco.
R. E. Fisher, Pacific Gas & Electric Co., San Francisco.
R. M. Alvord, General Electric Co., San Francisco.
C. A. Luckenbach, Los Angeles Gas & Elec. Corp., Los Angeles.

Pacific Coast Gas Association Convention

The executives of the Pacific Coast Gas Association in preparing for the 25th annual convention at Santa Cruz, September 18-21, 1917, are displaying unusual activity looking toward the most successful gathering ever held by this association, so well known for its helpful "get-to-gethers." This enthusiasm is best displayed by recounting the happenings of the last quarterly round-up in Los Angeles.

The Pacific Coast Gas Association held its second annual get-together dinner of the present season at the Hotel Alexandria, Los Angeles, on the evening of Saturday, June 9th.

It was in every respect a representative gathering of leading lights of the gas industry on the Pacific Slope. The "Pacific Service" contingent consisted of Messrs. Henry Bostwick, Van E. Britton, John A. Britton Jr., Leon B. Jones, W. M. Henderson, M. L. Neely and F. S. Myrtle. As was natural, the large majority of the attendance hailed from the southland, the Los Angeles Gas & Electric Corporation being notably well represented. There were present also a number of appliance men, a branch of the industry that is steadily augmenting its membership in the association. Altogether, an assemblage of one hundred and thirty-two gathered at the dining tables spread in the spacious hotel ballroom.

President C. B. Babcock was in the chair. During dinner some attractive "stunts" were pulled off by fair local entertainers, who sang and danced charmingly. A prominent feature of the vocal part of the entertainment was the new patriotic song "We'll Stand by Uncle Sam," the music of which was composed by a "Pacific Service" man, H. G. Ridgway of the Marin district. After dinner came the speech-making program, led off by Mr. Henry Bostwick, the association's able and energetic secretary. It was cheering to note the receipt of thirty-one new applications for membership into the association, and loud applause greeted Mr. Bostwick's announcement of the decision of the executive committee to hold the convention at Santa Cruz this year according to schedule and not follow the action of some Eastern organization in postponing their annual gatherings on account of the war.

Mr. Wm. Baurhyte, who with Champ Vance headed the Los Angeles Gas & Electric Corporation's contingent, spoke words of welcome in his usual happy way. Then, in order, followed John A. Britton Jr., of "Pacific Service," editor of the Wrinkle department; A. B. MacBeth, Southern California Gas Company, Los Angeles, chairman of the Advisory Board; Paul Overton, Los Angeles Gas & Electric Corporation, chairman of the Legislation and Taxation Committee. All reported progress. B. S. Pederson, San Francisco, chairman of the Gas Exhibits Committee, told of the arrangements made for a representative exhibit at Santa Cruz this year. Paul Haugh, Los Angeles, told some clever stories. Leon B. Jones, of "Pacific Service," member of the executive committee, spoke of the progress of the gas industry and its prospects. F. S. Myrtle, "Pacific Service," reported for the Committee on Publicity. F. S. Wade, Southern Counties Gas Company and C. A. Luckenbach, Los Angeles Gas & Electric Corporation, both directors of the association, closed the speech making. Mr. Luckenbach amid great applause presented a paper read by him to the employes of his company on the subject of the Liberty Loan bonds, in which he urged quality as against quantity in measuring patriotic support and scorned the "financial slacker."

ELECTRICAL SUPPLY JOBBERS' CONVENTION

(The gathering of men of the electrical industry at Del Monte during the past semi-monthly period has been remarkable in that a high degree of comradery has been developed that is bound to have lasting results in even more helpful co-operative effort for the future. The golf tournament for the Red Cross which netted the national organization a hundred and ten dollars, gave a distinctly unselfish and patriotic tone to the gathering. The papers presented were unusually well written and a renewed spirit of loyalty was awakened.—The Editor.)

The mid-summer convention of the Pacific Coast Electrical Supply Jobbers' Association at Del Monte July 27-28-29, 1917, proved to have an unusual amount of ginger in the discussions, especially the open meeting on Saturday, July 29. In the unavoidable absence of Cap. H. F. Jackson, president of the Pacific Coast Section, N. E. L. A., who was to have delivered the paper of the meeting, Garnet Young of the Telephone Electric Equipment Co., San Francisco, delivered a paper on "Loyalty." Mr. Young brought out certain points wherein it was hinted that the manufacturer was not getting the full co-operation of the jobber, especially in certain lines of wire distribution to the trade. The jobber's viewpoint was ably defended by Tracy E. Bibbins of the Pacific States Electric Company who thus summarized the full defense of the ethics of the jobber in the following creed:

GARNET YOUNG, of the Telephone Electric Equipment Co., whose paper on "Loyalty" and whose excellent golfing won him distinction at the convention.

THE JOBBERS' CREED

That at all times I must be loyal to myself—my company and its policies.

That I should consistently support the manufacturer whose lines I have agreed to sell.

That every manufacturer who plays the game, whether I buy from him much, or little, should have from me all reasonable encouragement, and always a fair deal.

That I recognize the right of my competitor to live and prosper and no policy should be employed by me which is destructive to his rights.

That my first and last thought should be for the betterment of the electrical industry and the service to all my customers.

Such a house cleaning as resulted both in open expression at the meeting and in the individual thoughts of each person present will do much for a clearer and more open understanding between manufacturer and jobber for the future.

An unusual amount of good fellowship pervaded all the meetings at Del Monte, and the various golf tournaments were no exception. But to properly describe the good times enjoyed one must be present with them and mingle in their gatherings. Here are some of the incidents that gave life and enthusiasm to this meeting:

When John J. Gibson, manager of the supply department of the Westinghouse Electric & Manufacturing Company and a distinguished guest of the convention, spoke feelingly of dear little "seven toed Pete" and offered to take him back to East Pittsburg and there give him proper nourishment, a distinct feeling of sadness swept over those present for this little animal, the only one now in captivity, is dearly loved by the electrical jobbers.

And then there was Frank Fagan, western manager of the Edison Lamp Works of the General Electric Company, whose skill as an agriculturist in the growing of potatoes was bulletined on the main news board at the Del Monte. Secret investigation will undoubtedly reveal the fact that Mr. Fagan in some secret and mysterious manner is producing forced growth in potato culture by means of the Mazda lamp.

* * *

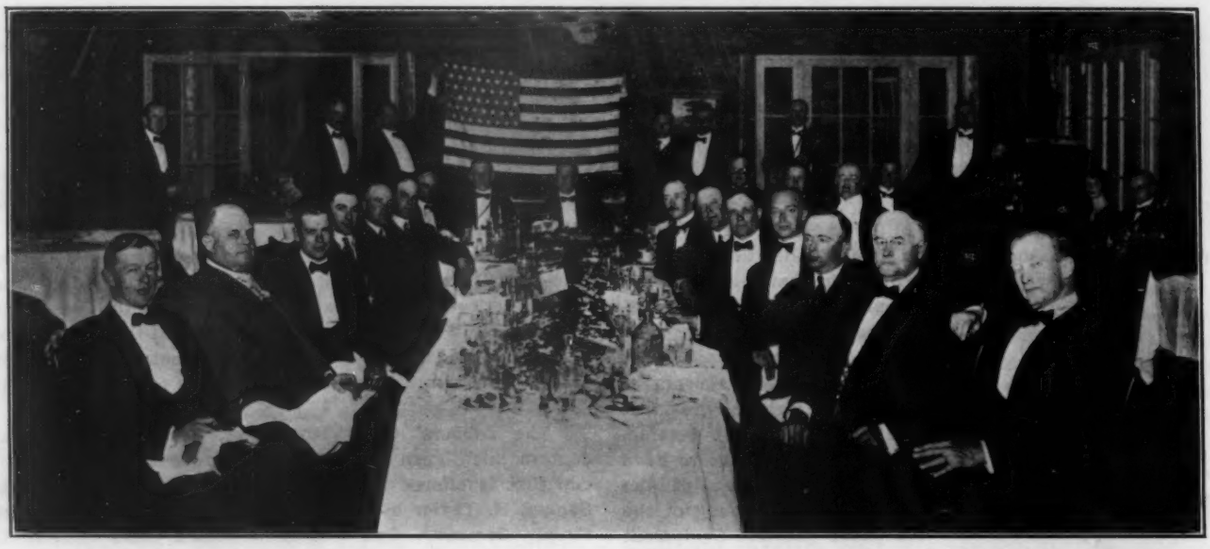
The Jobbers' Golf Tournament, around which always centers such keen interest in the race for the beautiful cup that is offered from year to year, was won by Colonel Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company, San Francisco, with a gross score of 104 and a net of 59. This conquest was peculiarly fitting in this instance, for Mr. Taylor is deserving of extra distinction at the hands of the Jobbers in that his present term as president of their organization is proving unusually helpful and profitable to all.

* * *

Garnet Young of the Telephone Electric Equipment Co., distingushed himself by knocking his golf ball up a tree from whose lofty branches he was enabled to see the nations of the world and by means of this enlarged vision he became monarch of all he surveyed and as a consequence won the manufacturers' cup with a net score of 64 and a gross of 84.

TRACY BIBBINS, PRESIDENT OF THE PACIFIC STATES ELECTRIC COMPANY

Mr. Bibbins, in his characteristically able manner, sounded the keynote of the convention in his terse, well-worded rule for men of the association by the presentation of "The Jobbers' Creed," which is presented elsewhere on this page of the Journal.



Standing at Left of Flag, A. M. Irwin, John J. Gibson

Standing at Right of Flag, W. R. Dunbar, C. B. Hall

Sitting at table, from left to right: H. H. Hoxie, P. J. Aaron, C. D. La Moree, Ray Murphy, Carl Will, L. W. Davis, Hugh Bargion, Samuel H. Taylor, Carl E. Heise, C. N. Aspinwall, W. C. Wurfel, Wm. Dick, Carl Wernicke, F. N. Averill, Samuel Adams Chase, C. B. Hawley.

At right of rear of table, sitting: A Youngholm, R. E. Van Kuren, R. F. Behan.

THE BANQUET OF THE WESTINGHOUSE GATHERING

One of the pleasing features of the recent gathering of the electrical Supply Jobbers' Association at Del Monte was the meeting of men of the West engaged in directing the affairs of the Westinghouse Electric & Manufacturing Company. The presence of John J. Gibson and Samuel Adams Chase from the Eastern offices added an agreeable tinge of dignity and spirit of good fellowship throughout the meetings both of the Westinghouse men and of the Jobbers' Association.

A beautiful and patriotic strain pervaded the convention doings. A golf tournament was played for the benefit of the Red Cross in which each entryman chose his own handicap and paid two dollars for the privilege. F. J. Airy, Los Angeles manager of the Pacific States Electric Company, and C. B. Hawley of the Intermountain Electric Company of Salt Lake City, each with a net of 72 and a gross of 122, tied for first place. The tie score was played out on Saturday and Mr. Airy won the beautiful gold Red Cross pin given as first prize. The total sum turned over to the Red Cross from this thoughtful and unselfish gift of the Jobbers was one hundred and ten dollars.

* * *

Mr. Hawley and his pal, R. S. Folland, of the Capitol Electric Company, Salt Lake City, were not to be downed, however over the results of the Red Cross tournament. Mr. Folland ably assisted by Mr. Hawley gave a demonstration during the evening of the banquet of why the lake level of the great Salt Lake is said to be slowly receding.

* * *

The Central Station's cup, a gift of the jobbers, was won by Geo. C. Holberton of the Pacific Gas & Electric Company, who played a gross score of 94 with a net of 66. Mr. Holberton's only rival, Stanley Walton of the Pacific Gas & Electric Company, received his reward on the evening of the banquet by being placed in a distinguished position among the jobbers by means of the graceful assistance of the giant, H. E. Sanderson, of the Bryant-Perkins Co. of San Francisco.

* * *

Charlie Hillis, of the Electric Appliance Company, of San Francisco, was the graceful recipient of a pair of beautiful silk garters for his golfing in the future, while Colonel Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company of San Francisco, will in future have the timely assistance of a model H curry comb to enliven the growth of beard he has carried with him for lo these many years.

* * *

To sum it all up, Ira J. Francis, of John Roebling's Sons Company, of San Francisco, proved himself brim full of humor and an excellent toastmaster. To turn the tables upon Mr. Francis it might well be said that while what he discussed so fluently pro and con was in itself 5 per cent pro and 95 per cent con, still it is safe to say the jobber and manufacturer will in the future co-operate on a 50-50 basis, each receiving for himself a "5" with its necessary goose egg to make it "fifty fifty" in its truest sense.

* * *

It was a thing of beauty and a joy forever to behold the manufacturers' talent that graced the honor table at the banquet with Ira J. Francis of John Roebling's Sons Company forming the graceful setting of a dozen bouquets, the gift of the jobbers present, and protected by a body guard of a dozen manufacturers on either side with Samuel A. Chase, the assistant to the manager of the supply department of the Westinghouse Electric & Manufacturing Company at East Pittsburg, bringing up the extreme right wing.

IRA J. FRANCIS, Western Manager of John A. Roebling's Sons Company, who proved himself an able and witty toastmaster and added much to the life of the convention.

* * *

W. S. Berry, the dignified salesmanager of the Western Electric Company, was presented with a windshield of plate glass, 2 by 5 ft., in order that the future growth of beard under his lower lip may proceed free from the interruption of the elements without.

* * *

Attendance at the Del Monte Convention

F. N. Averill, Fobes Supply Co., Portland.
P. J. Aaron, Fobes Supply Co., Seattle.
F. J. Aspinwall, Westinghouse Elec. & Mfg. Co., Seattle
F. J. Airy, Pacific States Elec. Co., Los Angeles.
R. N. Alvord, Generel Electric, San Francisco.
C. G. A. Baker, Baker-Joslyn Co., San Francisco.
T. E. Burges and wife, Baker-Joslyn Co., Los Angeles.
D. J. Butts, Western Elec. Co., Los Angeles.
N. A. Bowers, McGraw-Hill Pub. Co., San Francisco.
F. G. Beck, American Everready Co., San Francisco.
R. F. Beban, Western Electric & Mfg. Co., San Francisco.
H. L. Borgion, Montana Elec. Sup. Co., Butte.
T. E. Bibbins, Pacific States Elec. Co., San Francisco.
W. S. Berry, Western Electric Co., San Francisco.

E. M. Cutting, Edison Storage Battery Co., San Francisco.
J. N. Colkitt, John A. Roebling's Sons Co., Los Angeles.
R. B. Clapp and wife, Manufacturers' Agent, Los Angeles.
Samuel Adam Chase, Wastinghouse Elec. & Mfg. Co., East Pittsburg.
W. R. Dunbar, Westinghouse Elec. & Mfg. Co., San Francisco.
L. W. Davis, Westinghouse Lamp Co., Los Angeles.
W. M. Deming, Journal of Electricity, San Francisco.
C. C. Davis, Pacific Hardware & Steel Co., San Francisco.
R. J. Davis, Century Elec. Co., San Francisco.
Albert H. Elliott, Secretary Electric Supply Jobbers, Association, San Francisco.
R. S. Folland, Capitol Elec. Co., Salt Lake City.
Ira J. Francis and wife, John A. Roebling's Sons Co., S. F.
F. D. Fagan, General Electric Co., San Francisco.
C. H. Gilson, Gilson Elec. Sup. Co., Oakland.
S. W. Gilman, John A. Roebling's Sons Co., San Francisco.
S. B. Gregory, Arrow Elec. Co., San Francisco
John J. Gibson, Westinghouse Elec. & Mfg. Co., East Pittsburg.
C. E. Heise and wife, Westinghouse Elec. & Mfg. Co., S F.
Geo. C. Holberton, Pacific Gas & Electric Co., San Francisco.
H. H. Hoxie, Electric Ry. & Manufacturers' Supply Co.
C. B. Hall, Illinois Elec. Co., Los Angeles.
C. B. Hawley, Intermountain Elec Co., Salt Lake City.
C. C. Hillis, Electric Appliance Co., San Francisco.
D. E. Harris, Pacific States Elec. Co., San Francisco.
O. W. Lillard, Gould Storage Battery So., San Francisco.
C. D. La Moree, Westinghouse Elec. & Mfg. Co., Los Angeles.
E. H. Murray, National Carbon Co., Los Angeles.
J. G. Miller, Gilson Elec. Supply Co., Oakland.
Ray Murphy, Westinghouse Lamp Co., San Francisco.
Chester Manchester, Interstate Elec. Novelty Co., San Francisco.
C. F. Mason and wife, Pacific Tel. & Tel. Co., Los Angeles.
G. L. Orman and wife, Pacific States Electric Co., Portland.
J. G. Pomeroy and daughter, Bryant-Perkins Co., Los Angeles.
F. J. Quinn, Manhattan Elec. Supply Co., San Francisco.
D. Reynolds, Graham-Reynolds Co., Los Angeles.
H. E. Sanderson, Bryant-Perkins Co., San Francisco.
H. B. Squires, H. B. Squires Co., San Francisco.
Miles Steel, Benjamin Elec. Mfg. Co., San Francisco.
A. E. Sugden, Pacific Hardware & Steel Co., San Francisco.
Robert Sibley, Journal of Electricity.
E. B. Strong, Journal of Electricity, San Francisco.
Samuel H. Taylor, Elec. Ry. & Manufacturers' Sup Co., S. F.
J. A. Vandegrift and wife, Mazda Lamp Division, Oakland.
K. E. Van Kuren, Westinghouse Elec. & Mfg. Co., Los Angeles.
C. E. Wiggin, Dunham, Carrigan & Hayden, San Francisco.
S. V. Walton, Pacific Gas & Electric Co., San Francisco.
Carl L. Wernicke, Westinghouse Elec. & Mfg. Co., Portland.
C. M. Will, Fobes Supply Co., Portland.
W. C. Wurfel, Westinghouse Lamp Co., San Francisco.
H. F. Yost, Trumbull Elec. Mfg. Co., San Francisco.
Garnet Young, Tel. Elec. Equipment Co., San Francisco.
F. J. Zorn, Pacific States Elec. Co., Seattle.

W. S. Berry

Chin of W. S. Berry before the appearance of his "chinchilla"

Samuel H. Taylor

"Chinchilla" of Colonel Samuel H. Taylor which he has worn since the year one

Charlie Wiggin

"Chinchilla" of Charlie Wiggin, thoroughly concealing his chin, until his recent emancipation

THE EVOLUTION OF THE JOBBERS' "CHINCHILLA"

Much amusement was afforded members of the convention by its worthy toastmaster, Ira J. Francis, of John A. Roebling's Sons Company, in presenting W. S. Berry of the Western Electric Company, with a wind-shield to properly protect the growth of beard he has recently started, while to Samuel H. Taylor, of the Electric Railway & Manufacturers' Supply Company, who has for some years prided himself upon a protruding "goe-tee," he presented the latest model of curry-comb. Charlie Wiggin, of Dunham, Carrigan & Hayden, escaped unscathed in that he has long since given up ambitions of maintaining a growth upon his "chinchilla."

RECENT HAPPENINGS IN THE ELECTRICAL INDUSTRY

The Sperry Flour Company is completing its new electric flour mill at Spokane, Washington.

The Tacoma Railway & Power Company, has given its 225 trainmen a raise of one cent an hour. This went into effect on July 15 and is the second raise within the month, two cents an hour having been granted on July 1.

The San Diego Consolidated Gas & Electric Company has commenced rebuilding the electric distribution system at Escondido, Cal. This includes the installation of nine 250 watt lamps on Grand avenue and 104 100-watt lights in other parts of the city.

The Electro-Galvanizing Works at Portland, of which Martin Leiser is proprietor, is now doubling the capacity of the plant. The sum of $25,000 is represented in the proposed improvements. The name of the company has been changed to the Portland Galvanizing Works.

At a recent luncheon of the Centralia, Washington commercial club, R. Thomas of Portland, president of the Thomas Pulp & Paper Company, announced that his company would soon begin the construction of a power plant at Centralia and a paper mill in Aberdeen. Close proximity to lignite coal was the reason given for starting the power plant at Centralia.

George B. Cooley Electric Company, 813 Western avenue, Seattle, is busily engaged in installing electric lighting plants on twelve 8800 ton ships in the Duthie Yards and is making a large amount of water tight fixtures mostly for shipbuilding companies. A contract for installing light and power equipment in the forge shop of the Pacific Construction and Engineering Company on Whatcom street has been completed. Much armature winding is being done and many orders filled for the companys patented searchlight.

The Public Service Commission of Washington has been informed by the Puget Sound Tracton, Light & Power Company that the tariff providing for the sale of 25 tickets for $1 on the Seattle division will be canceled and two classes of fares charged beginning August 12. These will be a straight five-cent fare and half rate for school children. The company states that car rides cost more because labor, supplies, power equipment, etc., cost more. Trainmen's wages have been increased fourteen per cent in the past six months, another important item in the increased cost of operation.

An ordinance has been introduced providing for condemnation of right-of-way over which to build an elevated road from First and Washington streets to the Port Commission right-of-way, then down Railroad avenue and on Whatcom and Spokane avenues to the West Waterway. If this is built of wood which is probable, its estimated cost is $300,000 with $12,000 additional for sidewalk. Common users on other portions of the line would link up the two divisions of the municipal system. The idea is to bring to a paying basis the municipal lines which since they began operating have been losing money. On a line that would run from the industrial district to Ballard an estimated total daily revenue is available of $10. This of course will steadily increase as the industrial section develops. This development is taking place very rapidly. The extent to which the city lines would share in this would depend somewhat on the kind of service rendered. It is estimated that by the construction of a little more than four and one-half miles of track and the application of common user to one section of .859 miles, the city would have its more than 18 miles of track in one system and could then test out whether or not it will be possible to make the lines pay.

Suit to Enforce Service

W. V. Tanner, attorney general of Washington has started suit in the superior court of Pierce County, to secure a writ of mandate to compel the Tacoma Railway & Power Company to furnish the citizens of Tacoma with adequate transportation as provided in the franchise under which it operates. The suit is started as the result of the decision of the public service commission to proceed against the company after receiving a ruling from Attorney General Tanner to the effect that under section 93 of the public service law the commission has the power to act. The strike has been on for about two weeks.

Suit Against Traction Company

Suit has been brought against the Puget Sound Traction Light & Power Company for the sum of $60,917 as its proportion of the cost of constructing the Fremont avenue bridge. Judgment is also requested for interest at the rate of 6 per cent from the date of opening bridge on June 16. The company is also to be compelled if the court so decides to pay $333 a month as its share of the operation and maintenance of the bridge with one per cent kilowat hour for current consumption for cars crossing the bridge.

Seattle Wins Point

The city of Seattle in its legal fight to compel the Puget Sound Traction Light & Power Company to resume operations of its street cars won a point when Judge Neterer of the Federal Court remanded to the superior court the city's application for a writ of mandate. The city is asking for a receiver if the company does not comply with the writ. As a result of the decision by the Federal Court, the company will now be compelled to show cause why the writ should not be issued. The company has filed a demurrer to the case of the city, also an answer and the application will be strongly resisted.

The Re-districting of the Southern California Edison Company

From the standpoint of commercial development and with the particular end of supplying the most efficient distribution of electric energy from the various centers of generation and transmission, and to provide and care for consumers collectively and individually, the vast region of the Greater Edison System, has been divided into seventeen geographical districts. In the re-districting of the territory of the original Southern California Edison Company, and that formerly operated by the Pacific Light & Power Corporation, the boundaries of old districts have been changed and four new districts formed.

It is the opinion of Mr. S. M. Kennedy, the general agent of the company under whose direction the important work of redistricting has been conducted, that based upon intimate knowledge of the territories and the communities of each district, that the growth and development of the company's business, in the future, will ge even more rapid and satisfactory than was indicated by estimates made eighteen months ago, at which time the proposed merger which has since become a fact, was worked out on paper. More land is being brought under cultivation and more industries are springing up than could be reasonably figured on two years ago.

The Los Angeles district is naturally the center of the Greater Edison system, as the metropolis of the Southwest is the hub around which its wonderful activities revolve. It is in this district that the general offices of the company are located. The new directory census shows the population of the city to be 590,994. The magnificent twelve-story Edison Building, which is in course of construction on Broadway at Third street, will be one of the most attractive structures in the business district. It will be an imposing, but dignified edifice, and a radiant center of illumination at night.

Earnings Western States Gas & Electric Company

Net earnings of Western States Gas & Electric Company for the month of May were $48,557, a gain of nearly 10 per cent over May, 1916. Recent issue of $1,564,000 ten-year 6 per cent Notes provides for the retirement of the $621,500 three-year Notes due October, 1917, and floating debt, and furnishes funds for improvements and extensions to the properties and payment for new water rights and storage reservoirs in California.

Electrical Workers Ask Increase

Local Union No. 77 of the International Brotherhood of Electrical Workers, announcing that it represents the electrical workers employed in the city lighting department of Seattle, has asked the city council for the elimination of the grading of workers and the establishment of a scale of wages for the ensuing year, which averages $1.00 a day higher than the rate in effect before the recent blanket increase, the high cost of living being the justification. Meter readers under the 1917 budget, received $85 a month. Since the blanket increase they have been paid $95 a month; the proposed 1918 scale would give them $111. The figures for linemen, electrical machinists and inside constructors are $4.75, $4.95 and $5.75; for laborers $3.00, $3.50 and $4.00.

Interlinking the Electric Lines at Seattle

An attempt is being made to secure extensions to the present municipal street car lines in Seattle with a view to connecting them up and sharing in the traffic of some thickly populated districts as well as the chief industrial center of the city.

The plan is to build an extension 1.26 miles in length that will carry Division A from its present north terminus at 13th and Nickerson streets into Ballard. This would cross the Lake Washington canal on the 15th avenue Northwest bridge and tap a densely populated section of Ballard. The estimated cost of this is $27,320.

Utilities Commission of Idaho

In the matter of the application of Utah Power & Light Company for a certificate of public convenience and necessity in the village of Newdale, Fremont County, Idaho, the commission has ordered the company to continue the furnishing of electrical service.

In the matter of the application of the Shoshone County Power Company, a corporation, for a certificate of public necessity for the exercise of a franchise or transmission line in Shoshone County, Idaho, the commission has granted the request.

Seattle and Tacoma Car Strike

The Puget Sound Traction Light & Power Company and the Tacoma Railway & Power Company have found it impossible to reconcile their differences. The company in Tacoma is running a few cars but so far as Seattle is concerned not a wheel is turning so far as the traction company is concerned. The company has refused to recognize the right of the employes to affiliate with the Amalgamated Association of Street Railway Employes. Both the Tacoma and Seattle car men have flatly declined to accept the company's proposal. The strikers are represented by C. A. Reynolds who in anticipation of the rejection of the offer has telephoned to Henry M. White, federal labor conciliator, asking him to telegraph the department of labor at Washington, D. C., of the apparent deadlock and to recommend that the federal authorities take over and operate the Seattle street railway. Commissioner asked that the proposal be submitted in writing so that it could be included in a report to be telegraphed to the department. It is also reported that the federal government through the commissioner of labor

is negotiating through the Boston office of Stone & Webster for a settlement. There is a possibility that the men at the power plants and sub-stations of the Puget Sound Traction Light & Power Company may strike as there has been a move to this effect.

Suit Against Industrial Accident Commisison of Washington

The Washington Water Power Company of Spokane has started suit in Thurston county superior court against the industrial insurance commission to restrain it from collecting premiums either for the industrial insurance or first aid on the ground that the last legislature in enacting the law to exempt steam roads doing an interstate business, included the electric lines doing similar business.

British Columbia Company Proposes Sale to Province

The British Columbia Electric Railway Company has expressed a willingness to dispose of its holding in the province, if satisfactory terms can be secured. This was intimated to the Mayor Vancouver by General Manager Kidd. The price set on holdings on the lower mainland was $30,000,000 The company is willing to accept bonds to the extent of $25,000,000 bearing 5 per cent and the remaining $5,000,000 without interest for five years.

New Business—Seattle District

The Moran Engineering Company, 1220-1222 First Avenue South, Seattle, builders of the Moran centrifugal pumps, of all sizes from one to six inches, have contracts on their books for something like 500 pumps.

Enterprise Brass Foundry, 2727 Seventh Avenue South, Seattle, has installed the latest equipment in oil burners and cranes which will enable them to handle unusually large work. The plant is loaded up with work that will last several months, much of it being for shipping interests.

Gray & Barash Company, Incorporated, First Avenue South and Jackson street, Seattle, electrical engineers and contractors, have leased a site comprising a block at Horton avenue and Colorado street in the South Canal Waterway addition and will erect a large plant. Extensive orders for electrical machinery and equipment for the numerous ships under construction and proposed has led to this step in order to better handle the business.

Aubry & Wire have just completed a modern electrical installation in the Wright Shipyards at Tacoma. The switches are of the automatic oil type with relays for each motor, doing away with the old fuses.

New Business—Los Angeles District

The new substation at Los Alamitos was put in operation on July 15th. This station has a capacity of 4,500 kilowatt and will serve the sugar factories in that locality along with local distribution.

The department of distribution is now deep in the task of re-arranging the lines in the different districts to do away with duplication and to standardize to either 10,000 volts or 15,000 volts where both were formerly present. The problem of confining metering within distinct district boundaries is no easy task and is only one of the few problems brought about by the recent consolidation.

Jitney Bonds in Washington

The Republic Casualty Company of Pittsburgh, Pa., has been licensed to write jitney and other surety bonds in the state of Washington. The federal court recently issued a temporary injunction against the operation of these bonds in Seattle without a license.

Judge Neterer of the United States District Court has granted a temporary injunction against 179 jitney drivers of Seattle on the application of the Puget Sound Traction, Light & Power Company. The court held that until the drivers had filed bonds as required by law they had no right to interfere with the rights, franchises, or privileges of the plaintiff. The court further held that such operation of jitneys constitutes a nuisance on the public streets of Seattle and that there can be no doubt that the complainant suffers special damage in loss of revenue on account of these acts, that there is no authority for operating free busses and such conduct is clearly an invasion of the company's rights which the law will not countenance or permit.

New Power Loads

The Swayne Lumber Company, Oroville, has recently been purchased and will be operated on a much larger scale in the future. It is planned to electrify the entire mill to the extent of 300 h.p. This is one of the largest lumber mills in this section of the state.

The Theo Dittel Company has recently installed a large porcelainware plant near Pittsburg, Contra Costa County. This plant will prove a very interesting installation owing to the nature of the finished product and to the process of manufacturing. The initial installation will be 150 h.p.

The Pacific Foundry Company, Eighteenth and Treat streets, San Francisco, has found it necessary to install 100 h.p. additional in motors at its factory, owing to the increased business.

The Pacific Pipe Company, 450 Main street, San Francisco, has installed 50 h.p. additional to take care of the increased business at their pipe works.

The Golden State Baking Company, 1231 Howard street, San Francisco, has made an additional installation of 40 kw. for battery-charging purposes to supply eight electric trucks necessitated by its increased business.

The Alameda Sugar Company has installed an additional 100 h.p. motor-driven plant for the irrigation of sugar beets near Meridian, Sutter County.

Messrs. C. A. Wixon and W. A. Wotherspoon have recently opened up a gravel mining proposition at Mokelumne Hill, Calaveras County, and their initial iinstallation will be in the neighborhood of 30 h.p.

The Lakeside Golf Club, situated near Lake Merced, San Francisco, has just completed one of the most completely equipped and finest golf links in the United States. A total of approximately 100 h.p. has been installed for pumping and other power purposes, as well as for a large amount of lighting.

The Roseville Water Company has announced its intention of installing two 75 h.p. motor-driven pumping plants in order to supply the city of Roseville with water. These plants will be served by the Pacific Gas & Electric Company.

The Diamond Match Company, located at Chico, California, is now engaged in greatly enlarging its plant; several new fireproof buildings have been erected and its electrical equipment is now being installed. The present power capacity is 1600 horsepower, which will ultimately reach a total of 2500 horsepower.

New Engineering Firm in San Francisco

John A. Rice announces that he has established permanent office headquarters at 525 Market Street, San Francisco, where he is at the service of his clients. As consulting mining engineer and geologist, he is prepared to make examinations of mines for investors, to conduct geological investigations, and to undertake the directing of mine development or of operations which require special geological exploration.

A REVIEW OF RECENT BULLETINS

Scientific and Engineering

The Beckman & Linden Engineering Corporation of San Francisco who are the engineering representatives of the Electro Metals Company, have just distributed to engineers interested a three hundred page book setting forth in detail the recent hearing of the Electro Metals Company before the California Railroad Commission in its effort to secure low rates for power from the Pacific Gas & Electric Company, the Great Western Power Co., and the Sierra & San Francisco Power Co.

Of interest to all engaged in a study of reducing household costs are the recent bulletins of the agricultural experiment station of the University of California on growing vegetables under contract, living expenses, jelly stocks, fruit juices and canning of fruit and vegetables.

The determination of nitrogen in substances used in explosives and the ores of copper, lead, gold and silver are treated in technical papers 160 and 143, respectively, just issued by the Bureau of Mines.

The book paper industry is set forth in a letter from the Federal Trade Commission transmitting a preliminary report on the book paper industry to the U. S. Senate. Much of interest to all having to do with the present high price of paper is there to be found.

The Arizona Council of Defense has published a twenty page booklet on its purposes and a brief statement of its work, accomplished and under way.

The Chamber of Commerce of the United States is distributing publicity matter on the present organization of the National Defense Board, its present means for meeting the situation, the work of advisory committees, why central authority is needed and the coal agreement together with other matters of national concern.

A paper on an automatic starter for induction motors presented by H. F. Stratton before the Association of Iron and Steel Electrical Engineers at Chicago is being distributed to the trade by the Electric Controller & Manufacturing Co., of Cleveland, Ohio.

The effusion method of determining gas density is the subject matter of technologic paper 94 just issued by the Bureau of Standards.

The engineering experiment station of the University of Illinois has recently issued circular No. 4 on the economical purchase and use of coal for heating homes with special reference to conditions in Illinois.

Millard's Review of the Far East is a new publication making its appearance at Shanghai, China. Its columns deal with problems of a commercial nature that are now open for solution in China. The publication should prove especially useful to engineers who contemplate—. It is published weekly and sells for twenty cents a copy.

Illumination Advance

Imperial flood light projectors and imperial reflectors are discussed in a thirty-two page booklet just issued by the Crouse-Hinds Company of Syracuse, N. Y.

Crocker-Wheeler motor generator sets for all purposes are described in bulletin 181 now available to the trade.

Review of Utility Magazines That Appear on the Editor's Desk

The Pacific Service Magazine of July appears in its usual attractive mountain scenic covering. The leading article is devoted to the passing of the old Yuba power house and its historic interest. The issue is brim full of new industrial life that is being served by Pacific Service. Three columns on the editorial pages are devoted to a review and discussion of Mr. C. E. Grunsky's series of articles on rates that is now appearing in the Journal of Electricity and creating such wide spread interest.

The Pacific Telephone Magazine for July is most attractive in its front cover with the red cross nurse silhouheted against a red cross in the back ground. The issue is largely devoted to patriotic matters and devotes especial attention to the splendid patriotism that is being displayed by the telephone employes in the organization of the Signal Reserve Corps service.

The Pacific Power & Light Company's Bulletin for July deals editorially on the food control problem. Its leading article is devoted to a description of the new transmission line to Lind. Many interesting news items are given that display the activity and esprit de corps of this enterprising company.

Edison Current Topics, published by the Southern California Edison Co., is always welcome and inspiring. The issue for July is largely devoted to a description of the new the Pacific Light & Power Corporation into the greater Edison the Pacific Light & Power Corporation in the greater Edison now reorganized and well on its way for the attainment of its high service ideals.

Upbuilding of Electrical Industry

Engineers and others that are interested in the financial condition of the nation as summarized monthly for investors will find much of interest and profit in the four-page pamphlet that is distributed each month by Wm. Morris Imbrie & Co., members of the New York Stock Exchange, 61 Broadway, New York City.

The "Monthly Sales Service" for August published by The Society for Electrical Development, Inc., is not only replete with helpful suggestions but contains an enlarged illustration for window decorative purposes which forcefully sets forth the powerful hand of electricity in upholding the industries and very existence of the nation.

The "Official Bulletin" is the name of a daily that is being published under the order of the President by the committee on Public Information. The bulletin is now seventy-five days old and is proving remarkably efficient in disseminating useful and reliable information regarding the doings of national importance at Washington.

Edison storage batteries for industrial transportation are discussed in a thirty-two page pamphlet just issued from Orange, N. J., the company headquarters. The booklet is well illustrated with technical descriptions of the battery and the applications of the battery in countless industries for driving transportation vehicles.

Viele, Blackwell & Buck of New York City have recently published a handsomely illustrated booklet on hydroelectric and steam plants setting forth the construction work that has been carried on by its offices individually in various parts of the United States, Canada and Mexico. The leading illustrations are devoted to the Great Western Power Company's Feather River development which was designed and constructed by this group of engineers.

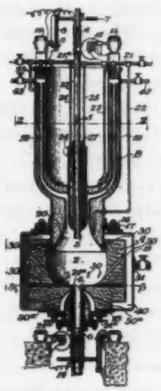
The Commerce Reports, which constitute a daily consular service and are issued by the Bureau of Foreign and Domestic Commerce of the Department of Commerce at Washington are becoming more valuable each day to engineers and commercial organizations throughout the West. These printed reports are for sale by the Superintendent of Documents at Washington, D. C., at $2.50 per year. To those interested in getting reliable information concerning the engineering and commercial development of our foreign neighbors, they are invaluable.

WHAT WESTERN INVENTORS ARE DOING

(An economic means for the fixing of atmospheric nitrogen in the West is a problem of vast importance. Since an abundance of water power is available and inexhaustible deposits of limestone and other minerals necessary in the manufacture of nitrogen products are available on all sides, the advent of industries of this nature awaits but the hands of the inventor to make a wide application for electrochemical processes throughout the section of the country. Here is a brief of a recent invention in California on an electric furnace for fixing nitrogen. Briefs on inventions for an automatic signal, an alluminated advertising vehicle-roof, a trolley wheel and an electric furnace are also appended.—The Editor.)

1,232,179. **Electric Furnace for Fixing Nitrogen from the Air.** Svend Barfoed, Oakland, Cal.

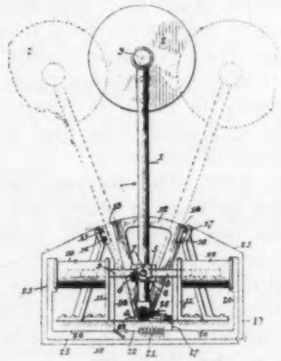
The combination with an electric furnace having a pair of electrodes mounted therein and a source of current supply for maintaining an arc between the electrodes, of means for



delivering air or gas to the furnace and directing it through the sphere of action of the arc and a cooler having an annular cooler discharge passage of large area compared to its volume formed therein directly connected with the furnace to rapidly decrease the temperature of the air or gas after it leaves the electric arc.

1,231,847. **Automatic Signal.** John M. Carson, Los Angeles.

A signal device comprising a swinging arm, a swinging contact member moving about same center as the said arm, circuits including magnets adapted to be energized alternately for drawing the said arm one way or the other, pairs of con-



tacts one of each pair being connected with a source of electrical energy, and one of each pair with one of the magnets, the movable contact member being carried by the said swinging arm against the said pairs of contacts, alternately for bridging those which will complete a circuit through a magnet, first on one side of the arm and then on the other side,

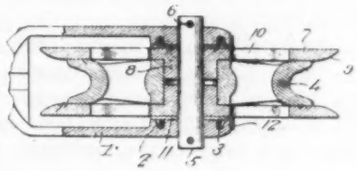
1,232,037. **Illuminated Advertising Vehicle Roof.** Auguste Jaminet, San Mateo, Cal.

In a vehicle roof construction, a long uninterrupted outside translucent advertising or destination sheet, forming part of the body of a vehicle, a bracket opposite or adjacent to a mediate portion of the sheet supporting a roof of the vehicle above the sheet and supported upon the body frame below

the sheet, suitably located lamps, and a reflector supported by said bracket and concave to said sheet and lamps.

1 231,630. **Trolley-Wheel.** William O. McKinlay, Westport, Wash.

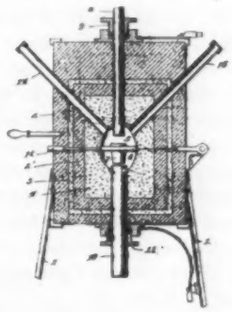
The combination with a trolley harp, of plates rotatably mounted therein, said plates equipped with hubs, a wheel



rotatably mounted upon the hubs, and means for holding the plates in frictional contact with the wheel.

1,232,362. **Electric Furnace.** Claude G. Miner, Berkeley, Cal.

In an electric furnace, outer and inner spaced walls and heat insulating material in the space between said walls; said furnace formed interiorly of said inner wall with a re-



action chamber having the shape of two opposed paraboloids; and a crucible composed of conducting material in the principal foci of said paraboloids, said crucible constituting a center electrode for two arcs in series.

NEW ELECTRICAL DEVELOPMENTS

(Interest of the past semi-monthly period has largely centered in following the plans of the Southern California Edison Company in its financing of its ten million dollar bond issue, three million of which is to go to the immediate installation of a second unit of the Big Creek development recently acquired by the company in its absorption of the Pacific Light & Power Corporation. It is believed that the strong financial showing of the company and its splendid accomplishments of the past will be of material aid in bringing out the early financial support desired. Other items of electrical development throughout the West follow.—The Editor.)

FINANCIAL

LASSEN, CAL.—The directors of the Baxter Creek Irrigation District have sold the first $300,000 bond issue of the district and bids for construction work are now being received.

SONORA, CAL.—A special election for a bond issue in Sonora has been set for the near future. The issue calls for $45,000 to install a municipal lighting system and power station for this city.

SUSANVILLE, CAL.—The sale of $300,000 of the first issue of the Baxter Creek district irrigation bonds was completed when H. M. McDonald of Los Angeles took the entire issue, paying 97 2-10 and accrued interest. This is one of the highest prices ever paid for irrigation bonds in the State of California, and is remarkable considering that these are the first water bonds offered east of the Sierras.

ALBANY, ORE.—The proposition of voting $250,000 in bonds for the purpose of purchasing the water system and the light and power plant from the Oregon Power Company, will be put before the people at a special election in December, or at the general election in November of 1918. The Oregon Power Company is now in the hands of the receiver and a public auction will be held on August 13, from the steps of the court house. The estimated cost of a new plant would be $400,000.

SAN FRANCISCO, CAL.—The statement of earnings of the Coast Counties Gas & Electric Company for the six months ended June 30 shows that the company finished the period with a balance of $39,079 after bond interest and all other charges. The comparative statement follows:

Six months to June 30—
Gross earnings, 1917, $177,501.63; 1916, $168,733.97.
Operating expenses, including taxes, 1917, $88,331.10; 1916, $84,764.48.
Net operating income, 1917, $89,170.53; 1916, $83,969.49.
Bond and debenture interest, 1917, $37,795.34; 1916, $38,444.40
Other interest, 1917, $1506.10; 1916, $1873.13.
Net operating earnings, 1917, $49,869.09; 1916, $43,651.96.
Amortization of debt discount and expense and depreciation, 1917, $10,789.74; 1916, $10,779.30.
Surplus, 1917, $39,079.35; 1916, $32,872.66.

LOS ANGELES, CAL.—Plans of the Southern California Edison Company to immediately expend $3,000,000 on its Big Creek hydroelectric plant and on the transmission line to Los Angeles, have been completed. In addition to the $3,000,000 for improvement work, the proceeds of the bond sale will be used as far as available, to pay obligations amounting to $983,287.44 for purchase of stock of Mt. Whitney Power & Electric Corporation, to pay obligations amounting to $4,000,000 for the purchase of $5,000,000 of first and refunding bonds of Pacific Light & Power Corporation and to pay in part the outstanding notes of the Edison Company and the Pacific Corporation amounting to $5,554,891. The bonds are to be issued in series, each series to mature at a date and bear interest at the rate to be determined by the directors of the company. The 1917 series matures July 1, 1919, with interest at 6 per cent. The company states that a syndicate will underwrite the $10,000,000 issue so as to net the company 95.62 and to return the syndicate and its managers 3 per cent.

INCORPORATIONS

RENO, NEV.—The Benham Irrigation Company has been incorporated in this city.

NORTHPORT, WASH.—The Northport Light & Power Company has been incorporated here.

OGDEN, UTAH.—The Buckle Electric Company has been incorporated here by J. V. Buckle, M. M. Allison, Mary E. Peck, Gladys Buckle and J. G. Larson.

TOWER, WASH.—The Farmers Mutual Telephone Company has been incorporated in this place.

RICHLAND, CAL.—The Eagle Telephone Company has been incorporated here with a capital stock of $1560.

MILES CITY, MONT.—The Deschner Electric Company has been incorporated here by A. J. Deschner and others.

LOS ANGELES, CAL.—The Anderson Electric Car Company of California has been incorporated here by Fred S. Rogers, W. C. Anderson and T. K. Lemmon.

SAN FRANCISCO, CAL.—The California Gas Utilities Company has been incorporated here by W. M. Hunter, C. H. Mathison, M. Waldmeyer, J. A. Phelps and E. R. Ramsey with a capital of $100,000.

TRANSMISSION

CENTRALIA, WASH.—The president and manager of the Thomas Pulp & Paper Company plans to erect a power plant in Centralia.

SALEM, ORE.—The Salem Electric Company has been awarded the contract for the wiring of the new O. A. C. library in Corvallis.

SAN FRANCISCO, CAL.—The Sierra Electric Construction Company has moved to 619 New Call Building. H. H. Van Luven is manager.

ALBUQUERQUE, N. M.—Plans for the extension of a trolley line from the present terminus at University Heights at least a thousand feet, are being considered.

TWIN BRIDGES, IDAHO.—A high tension electric power line is to be built 14 miles from Twin Bridges to the Bielenburgh-Higgins and the Lake Shore mines, to cost $26,000.

OAKLAND, CAL.—An ordinance forcing the Great Western Power Company to place its power lines underground within the limits of a zone to be fixed later was urged by Mayor John L. Davie in council.

LOVELOCK, NEV.—The Nevada Valleys Power Company is to extend its lines in Storey and Lyon counties, to connect with the new power plant under construction at Ditho, on the Truckee River.

SAN FRANCISCO, CAL.—Plans have been received by Public Works Officer C. A. Carlson at Mare Island for a one-story frame operating room which is to be erected at the wireless station at San Francisco.

VANCOUVER, WASH.—Bids have been asked for by the state board of control for razing the old administration building at the state school for the blind in this city. In its place will be constructed a brick power plant.

LOS ANGELES, CAL.—The bid of the Southern California Electric Company has been accepted by the board of education for the installation of electrical work in the new Los Angeles High School, on a bid of $3928.

RENO, NEV.—The Nevada Valleys Power Company, operating a plant at Lahontan and now furnishing power for Lovelock, Rochester, Packard and other districts in Humboldt County, is going to extend its lines into Washoe County.

TUCSON, ARIZ.—The Ajo Implement Company has petitioned the board of supervisors for a franchise to supply the townsite of Ajo and vicinity with water, electric light, telephone, telegraph, gas and sewer service for domestic and commercial use.

PASCO, WASH.—C. S. Knowles, superintendent of construction for the Pacific Power & Light Company, is in this city with an engineer and crew advancing the work of the new central switching station for the 66,000 volt system that will be installed here. It is estimated that the cost will be $100,000.

LOS ANGELES, CAL.—Chief Electrical Engineer Scattergood plans to install an auxiliary power plant in San Francisquito Canyon, to be ready for service within a few months. The public service commission has awarded to the Westinghouse Electric Company, the contract for the generator, transformer and equipment for this plant, the price being $31,735.

GOLDFIELD, NEV.—A high tension power line will be built from Verdi to the Poeville mining districts on Peavine mountain a distance of four miles, by the Truckee River General Electric Company. The line will be put in to supply power to the mines operating in that district and surveys will be started at once. It is expected that other companies operating in that district will take advantage of the power line and will install electric plants.

MODESTO, CAL.—Settlement of litigation over certain water rights on the Tuolumne River between the Modesto and Turlock irrigation district and the Yosemite Power Company, which has covered a period of 10 or 12 years, has been made and the power company has been awarded 66 second feet of water of the Tuolumne River. This will be measured at the La Grange dam, near where the company has a power plant and mining interests. The Yosemite Power Company is an outshoot of the Mt. Whitney Power Company, owned by John Hays Hammond interests.

LOS ANGELES, CAL.—An amendment to the city ordinance regulating electric wiring in buildings exempting dwellings of qve rooms or less from the provision requiring the placing of wires in rigid metal conduits, has been recommended to council by the committee on public safety. Many protests have been made by the owners of small dwellings against being compelled to install wides in rigid metal conduits because of the great expense as compared with the knob and tube system, which the public safety committee regards as sufficiently safe for small houses.

TRANSPORTATION

SEATTLE, WASH.—An extension of the municipal street car system that will cost close to $500,000, has been authorized by the city council.

SAN FRANCISCO, CAL.—The City and County of San Francisco by Eaton & Smith has awarded the contract to H. S. Tittle, contractor, for supplying trolley poles and electric work for the Twin Peaks tunnel for $10,179.

TACOMA, WASH.—An ordinance was introduced in the city council recently to purchase a machine to convert alternating to direct current for the use of the municipal street car line. The machine will cost $22,000 and will transform 4000 volts of alternating current into 600 of direct.

RICHMOND, CAL.—Although the Southern Pacific Company's franchise for an electric railway along Cutting boulevard to Tenth street and north on that thoroughfare to its main line tracks expired last year, the company, according to City Attorney D. J. Hall, is preparing to go ahead with this work shortly.

ILLUMINATION

LOS ANGELES, CAL.—A new ornamental lighting system is planned by this city.

SAN LUIS OBISPO, CAL.—The city council of San Luis Obispo is receiving sealed biids for furnishing gas or electricity for lighting the streets and public buildings of this city.

SAN DIEGO, CAL.—A petition applying for the formation of a public highway lighting district of the Normal Heights district has been filed with the clerk of the board of supervisors.

HALFWAY, ORE.—The city council has granted to the Idaho Power Company, a franchise until April 1, 1967, to operate in the town of Halfway, Baker County, Ore., electric light and power lines.

LOS ANGELES, CAL.—A petition has been filed with the board of supervisors asking for the establishment of a highway lighting district, to be known as the Stephenson Avenue and Laguna Lighting District of Los Angeles County.

LIVINGSTON, CAL.—The Livingston board of trade is now circulating a petition asking the supervisors to call a special election to vote on the proposition of the formation of a lighting district, to take in all of the two town sites.

HANFORD, CAL.—A new system of electric lighting will probably be adopted by the city shortly, electroliers being substituted for arc lights in the business section, while new lights will be installed throughout the residential portion of the city.

VENTURA, CAL.—Not only will Main street from Figueroa to Chestnut be equipped with ornamental lights, but California from Poli to Santa Clara Street will likewise be lighted, according to a motion passed at a meeting of the board of trustees.

REDWOOD CITY, CAL.—The Pacific Gas & Electric Company has submitted a bid offering to furnish 15-100 refractor style unit candle power lamps for Visitacion Valley lighting district for $2.15 for each lamp per month. The bid was accepted.

RICHMOND, CAL.—The most important rate investigation here since that recently held over rates of the East Bay Water Company, promises to be the one now started by Richmond into the charges made for gas service in the city by the Pacific Gas & Electric Company.

SAN FRANCISCO, CAL.—The Point Lobos Improvement Club has appointed a committee to confer with Mayor Rolph, the board of supervisors and local lighting companies in an effort to obtain a more extended and uniform street lighting system for the Richmond District and Golden Gate Park.

AUBURN, CAL.—The Pacific Gas & Electric Company has secured an injunction against the board of supervisors, sitting as a board of equalization, prohibiting the board from raising the assessment of the company's non-operative property in Placer County. The increase sought to be made was $58,430.

SANTA CRUZ, CAL.—A forest fire, which some weeks ago swept timber lands in this vicinity, leaped from smoldering embers into flame again last week. With renewed vigor it burned on a seven-mile front, destroying, it is reported, the plant of the Coast Counties Gas & Electric Company at Mill and Big creeks, a number of houses and valuable timber.

PENDLETON, ORE.—A new lighting system for Pendleton and the removal of electric poles and wires from Main street are improvements being contemplated by the Pacific Power & Light Company, according to the local manager. The plan would cost the city about $800 more a year and would cost the company $7000 or $8000 more annually.

EL CENTRO, CAL.—A special session of the city council will be held to consider a report of a committee delegated to investigate the condition of the conduit system employed in lighting of the Stone Pacific Addition on the North Side. A delegation from this addition petition the council to take over the lighting system, but before taking definite action on the matter an investigation of the system was to be made.

MOJAVE, CAL.—At a representative meeting of the business men the street lighting proposition for the town was given a good start. The meeting was held under the direction of the board of trade, and F. S. Smith of the Edison Company gave considerable detail as to style of lights and cost. The lamps proposed to be used are the tungsten incandescent. The matter of circulating a petition for an election for a lighting district was taken up and Constable Hamilton volunteered to get signatures. A plan of this district has been made by the secretary. This must be sent in with the petition to the board of supervisors.

TELEPHONE AND TELEGRAPH

SAUSALITO, CAL.—The board of trustees have sold a telephone franchise to the Pacific Telephone and Telegraph Company.

INDEPENDENCE, CAL.—A motion was carried at the Obispo is receiving sealed bids for furnishing gas or elec- Frank Pellisher and E. S. Moore for a franchise to maintain a telephone line in certain portions of Inyo County be accepted.

ENTERPRISE, ORE.—An ordinance has been passed by the city council granting the Home Independent Telephone Company the right to operate in the city of Enterprise, Ore. The franchise shall be in force for a period of 10 years from the date.

SUNNYSIDE, WASH.—The city telephone company is asking for a franchise to operate in the city with terms similar to the old ones which the two companies held. The City Telephone Company wants to construct under ground cables instead of the overhead lines that are now in use.

SAN FRANCISCO, CAL.—The California Telephone & Light Company earned its interest more than two times during the twelve months ended May 31, 1917, according to the earnings statement received by the National City Company. The comparative statement follows: Twelve months ended may 31, 1917, gross revenue $135,532.47, 1916; $126,323.96. Operating expenses, maintenances and taxes, 1917, $78,552.29; 1916, $77,450.71. Net incomes, 1917, $56,980.18; 1916, $48,-873.25. Interest charges, 1917, $27,908.18; 1916, $26,018.42, Balance 1917, $29,071.69; 1916, $22,854.83.

IRRIGATION

SANTA BARBARA, CAL.—On the Jacobson ranch a complete water system, piped to every part of the land has been installed and it is the plan of the owner to continue this water system over the adjoining places.

ALPAUGH, CAL.—Work has been completed on sufficient of the laterals of the Tulare Lake Water Company's system for the irrigation of 30,000 acres of land in the lake bottom, now either in the non-productive class or devoted to dry farming.

MODESTO, CAL.—The directors of the Modesto irrigation district have also decided to press the suit brought against the City of San Francisco to determine the water rights of the districts and of the city on the Tuolumne River, which were filed several years ago.

LODI, CAL.—The petitions for the organization of the Woodbridge irrigation district have been placed in the hands of the abstract company for the purpose of checking the signatures and mapping out the territory in the proposed district. The petition has about a hundred signatures.

WILLOWS, CAL.—A 150 ft. well is being drilled on the Christianson & Burmeister ranch five miles southeast of here, and twelve or thirteen others are to be installed in the near future. They are to be used for irrigating rice, and will supplement or replace water now taken from the West Side Canal Company's ditch.

WOODLAND, CAL., Plans not yet finally settled upon call for the irrigation of 12,000 acres of land in the northern part of the county, that is now devoted to dry farming only. It is proposed, if the tests show the scheme feasible, to install several pumping plants. The electric company, too, will be asked to install power.

WILLOWS, CAL.—That work will begin soon on the Cross irrigation project, known as the Central Jacinto irrigation project, is evidenced by the application made a couple of days ago to the state reclamation board for approval of the district's plan to install an intake in the Sacramento River. And although the date for the hearing has not yet been set, it is believed that it is not far off.

LODI, CAL.—The first papers of of the newly organized Wright irrigation district have been filed with the county clerk. The district is said to be composed of 19,010 acres of land belonging to 147 owners. The district is to take over the reservoir, dam and ditches formerly owned by the Stockton-Mokelumne Canal Company.

PALO CEDRO, CAL.—What may be called a home-made irrigation district has started off with furnishing an abundance of water for the irrigation of some 2000 acres in this neighborhood. Farmers early last fall formed the Big Cow Creek Ditch Company and commenced the construction of an irrigation system having eight miles of canal. Between 1000 and 1500 inches of water are turned on the land at a cost of only $5 an acre.

WILLOWS, CAL.—A contract is to be given in the very near future and possibly next week for the building of a big private irrigation system on the P. B. Cross property lying between here and the river. The 9000 acres belonging to Cross are to be irrigated for growing rice and and will require the building of about 10 miles of main ditch and a complete system of laterals. It is estimated that the work will require five months for completion.

FRESNO, CAL.—Land owners of Madera County in the vicinity will meet Saturday in the county seat of that county for the purpose of considering the formation of an irrigation district to irrigate from 300,000 to 400,000 acres. A reservoir to store the waters of the San Joaquin, Fresno and Chowchilla Rivers would cost in the neighborhood of $10,000,000, according to report of Louis C. Hill, Los Angeles engineer, who has also reported on the Pine Flat project in this county.

WASHINGTON, D. C.—Secretary Lane has announced conclusion of a contract with the Imperial Laguna Canal Company of Southern California, whereby a tract of between 120.000 to 200,000 acres of arid land adjoining the Imperial Valley is to be irrigated by an all-American canal thirty miles long. The water is to be taken from the Laguna dam of the Yuma reclamation project at Yuma, Arizona. A joint survey and examination of the canal route first will be made by the representatives of the government, the company and the State of California.

SUSANVILLE, CAL.—Engineer C. E. Grunsky and other officials of the Long Valley irrigation district made a trip to the Little Truckee River for the purpose of preparing for the survey of their 24-mile ditch to convey the waters of that stream to their project. The district has made application for permission to take 32,000 acre-feet of water from the Little Truckee. Survey of the canal will be commenced at once for the purpose of completing the details required in their report to the State Water Commission. The district has a natural storage basin at the Scott ranch in Long Valley which will impound 95,000 acres-feet of water. At the present time there is embraced in the boundaries of the district 28,000 acres of land.